THE

FOUNDRY TRADE JOURNAL

WITH WHICH IS INCORPORATED

THE IRON AND STEEL TRADES JOURNAL

VOL. 50 Thursday, May 24, 1934 No. 927

PUBLISHED WEEKLY.

Subscription Terms: 15s. per annum.
Foreign and Colonial: 17s. 6d. per annum.
All Subscriptions are payable in advance.

All Communications to be addressed to the Editor, the Advertisement Manager, or the Publisher of

THE FOUNDRY TRADE JOURNAL,
49, WELLINGTON STREET, LONDON, W.C.2

Telegraphic Address: "Zacatecas, Rand, London."
Telephone: Temple Bar 3951 (5 lines).

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN, THE INSTITUTE OF VITREOUS ENAMELLERS, THE NATIONAL IRONFOUNDING EMPLOYERS' FEDERATION, THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES' EQUIPMENT AND SUPPLIES ASSOCIATION

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Silica Slime

Elsewhere in this issue we print an abstract of an article which appeared in "Archiv für das Eisenhüttenwesen" by the late Mr. O. von Keil and three of his colleagues. This piece of research work opens up a new phase in the metallurgy of cast iron, as it indicates the profound influence of ferrous silicate or silicate slime inclusions on the graphite structure, the mechanical strength and other properties of cast iron. The authors have defined silicate slime as ferrous silicate existing in the molten cast iron in a sub-microscopical state of division. It can be eliminated by inhibiting the presence of ferrous oxide or of silica. When cast iron is prepared truly free from slime, then the graphite is in a finer state of division and the mechanical properties of the iron are improved to a considerable extent. These research workers have shown, as have Herty, jun., Sims and Lilliequist for steel castings, that it is not so much the quantity of non-metallic inclusions that has a deleterious effect upon the properties of the metal as their quality and the nature of their distribution. The problems on which this piece of research work will throw light are numerous. They involve the questions of rusty scrap, refractories for lining furnaces, the expansion of the electric furnace within the grey-iron foundry industry and their mode of working, the manufacture of chilled rolls and other hard castings. In this connection it is stated that by "removing the silicate slime, the carbon content and consequently the hardness can be increased without reducing the hardening depth." Then there is the relationship of silicate slime to the inherent properties of pig-iron, which involves the questions of high lime, and high alumina slags, and temperature, all to be co-ordinated with the condition of the graphite. This new angle on the metallurgy of cast iron (we anticipate contradiction on this point as there is nothing new under the sun) should be borne in mind by intending participants in the forthcoming Manchester Conference of the Institute of British Foundrymen, as Dr. Nipper, who is presenting a Paper on "Graphitisation," will no doubt be familiar with this piece of research work, and the potentialities of its industrial development.

The Centre of Gravity of Industry

We referred last week to the way in which a recent investigation of the Board of Trade had exploded the notion that has gained much currency in recent years about the alleged southern drift. It appears that there is little or no foundation for the idea that there is any transference of industry from the older industrial centres to the newer. There is, however, another aspect of this question which concerns a movement of another kind, but which in the very long run has a similar effect. The investigation showed that 409 factories had closed down and that 463 factories had opened. Now, of the 409, it is stated that 204 were in Scotland and Northern England. Of the 463, it is stated that 220 are in the south, round London, while only 141 are in the northern areas, which lost the 204. It is well known that changes in demand are giving rise to new industries of a comparatively light type, such as are suited to the south; but, apart from this, are we face to face with a condition wherein new industries tend to develop in the south rather than the north? This is not at all the same question as that of migration or transference of existing industries, but for the location of entirely new industries. Many such cases will come to mind.

If such a change is proceeding, it means that the industrial centre of gravity is changing both with respect to the type of product manufactured and the location, and in this there may be something in the idea for the southern drift; not as a physical transfer of an existing industry, but a growth of new industries in the south. Industry exists to serve the needs of an existing population, and where the population is, industry will follow. Perhaps nothing short of legislation restricting industrial development near London and in areas which we should like to keep clear for the health and leisure of the whole population would stop it. And that would help those industrial areas which have heavy commitments in things which cannot easily be transferred and which are now depressed.

Correspondence

[We accept no responsibility for the statements made or the opinions expressed by our correspondents]

A Manual of Foundry Practice

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—We have to thank your reviewer for the kind things he has said in your May 3 issue about our book, "A Manual of Foundry Practice," and we have duly noted the omissions so that they may be repaired, in the event, as we hope, of a further edition being called for. It would be improper for us to comment upon anything in your review which is a matter of opinion, but we may refer to a matter of fact, the remark of your reviewer that "the importance of total carbon is insufficiently stressed."

It should be noted, however, that, on p. 181 of the book, we discuss the variation of graphite content with that of total carbon, giving a graph (Fig. 109) showing this linear relationship plotted from the results of a large number of irons. On p. 186, we say: "Carbon lowers the melting point and increases the fluidity of the metal. A higher carbon content means more graphite, the direct relationship between these being well shown in Fig. 109. Since the breaking-up of the continuity and therefore the cohesion of the metal must depend—other things being equal—upon the quantity of graphite present, the tensile strength of the metal must vary inversely, both with the content of total carbon (Fig. 112) and with the content of graphite (Fig. 113), these graphs affording excellent confirmation of the theoretical deductions. Since there is a definite relationship (Fig. 114) between the amount of carbon in the cupola charge and that found in the resulting iron, the average proportion in the charge should be kept low, if high strength is required." Again, on p. 210, we say: "In general, high-duty castings necessitate the use of irons low in carbon and phosphorus, and cold or warm blast irons are more suitable." On p. 219, we mention, as one disadvantage of cupola melting, the large amount of carbon absorbed by contact with the fuel. In view of these statements, we feel that the comment of your reviewer is calculated to convey a rather erroneous impression.

It may, perhaps, be permissible to give a few words of explanation as to the metallurgical part of the book. It was at first intended that this should be written in a manner capable of being understood by a student and also more fully, as with the moulding section of the book. This was actually done, the result being that the book had assumed the length of 135,000 words, with 287 illustrations, which would have necessitated its being sold at a price of 25s. or so, a rather prohibitive figure, which would have seriously prejudiced its success. The necessary reduction to 90,000 words, with 150 illustrations, was made very largely at the expense of the metallurgical section, and it was then naturally impossible to deal with this section in the same complete manner, and all the earlier explanatory matter, together with sections dealing with centrifugal casting, die casting, etc., had reluctantly to be deleted. This is why the metallurgical part does not "balance" with the rest of the book, but demands a knowledge of basic principles before one can take full advantage of it. This, while quite unavoidable in these circumstances, is naturally also regretted by—Yours, etc.,

J. LAING.
R. T. ROLFE.

May 15, 1934.

[The above letter has been submitted to the reviewer, who still considers that insufficient stress is laid on total carbon when the authors discuss such matters as shrinkage and soundness. —ED.]

Production Costs and Selling Prices

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—From time to time articles appear on production costs and selling prices. Production costs must vary greatly as between quantity production and a jobbing foundry, such as the one in which I am interested. In many of the latter no costs are kept, but a blind hope is entertained that at the end of the year a return on the right side will result.

For purposes of comparison, I give the figures of a month's work on greatly decreased output, due to depression and variety of work which has to be dealt with in a jobbing foundry. The foundry is well equipped for lifting appliances and capable of dealing with castings up to 6½ tons. They are as follow:—

Skilled moulders' wages, 5s. 10d. per ton.
Coremakers', 1s. 2d. per ton.
Dressers', 1s. 0½d. per ton.
Labourers', 2s. 6d. per ton.

The "labourers" cost includes two furnacemen in addition to unskilled men, whose work is on the floor. The class of work varies from loam of 60 cwts. to dry- and green-sand castings of a few pounds.

The cost of production is taken as the sum expended in wages, overhead charges, scrap and pig, and coke and foundry requisites compared with the weight of castings as passed out over weighbridge. The proportion of coke to metal melted is 1¾ cwts. of coke to 1 ton of metal. This satisfactory proportion is due to careful weighing of *each charge* of metal and coke on platform before putting into cupola. It would be interesting to know if the results are at all indicative of conditions in similar cases.

Trade Union rates prevail in the district, viz.:—

Moulders, 66s. 9d.:
Coremakers, 54s. 9d.:
Dressers, 51s.:
Labourers, 39s. 6d.

all per week of 47 hrs.—Yours, etc.,

JOBBING FOUNDER.

May 15, 1934.

Molybdenum in Cast Iron

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—We would like to refer to an article in your issue of May 17, under the title of "The Addition of Molybdenum to Cast Iron for Foundry Purposes," and which was reprinted from the Spring issue of "Bradley's Magazine." In the first paragraph, the article mentions the cost of adding molybdenum, and while the figures were approximately correct when the article was written, it is probably advisable to point out that, on the present market price for molybdenum, the cost of additions to cast iron is now on the basis of £6 5s. per ton for each 1.0 per cent. of molybdenum, or 12s. 6d. per ton for each 0.10 per cent. molybdenum.

We shall be glad if you will also allow us to mention that the tests were made in co-operation with Messrs. High Speed Steel Alloys, Limited, of Widnes, who kindly supplied the molybdenum. —Yours, etc.,

Per pro BRADLEY & FOSTER, LIMITED,
G. T. LUNT,
Managing Director.

Darlaston.
May 19, 1934.

THE CENTRAL MARINE SHIPYARD of Messrs. W. Gray & Company, Limited, of West Hartlepool, which has not had a new ship on the stocks for 18 months, is to start work at once on the construction of two new paddle ferry steamers for the L.N.E.R.

Copper Prospects

By "ONLOOKER."

The adoption of the American Copper Code brings the industry in the United States definitely under the control of the N.R.A., but while realising that this event marks another milestone in the history of the metal, those who have perused the twelve clauses of this somewhat formidable document will probably pause to ask the question, which doubtless copper people in America are putting, "Can it be operated?" The measure became effective in April and is due for expiry in June, 1935, but so far it appears that little has been done under the new arrangement, apart from settling preliminary difficulties of which there are bound to be a good many.

The signing of the code did little or nothing to help the quotation, for in the absence of a minimum-price arrangement the 8½ cent level on the domestic market in the States remained unchanged, while in London the upward movement was so slight as to be almost negligible. As a matter of fact, there was a scare for a few days when non-Blue Eagle copper was offered by the Custom refiners at 8¼ cents, but evidently the sales clearing agent, or perhaps the code administrator himself, nipped this in the bud and no more was heard of a price below 8½ cents. The Custom refiners have now been fixed up with their production quotas, so, presumably, the way has been cleared for a fairly rigid price observance. This, of course, applies only to business on the home market, for as far as export trade is concerned there is no control over the quotation, and there is every indication that American copper will continue to come across to Europe as in the past.

As a price-raising measure the 4 cent import duty in the States has been a complete failure. Will the adoption of a code for copper bring any better result? With the world statistical position improving month by month as a result of the higher rate of consumption, there does not seem to be much chance of a fall in copper values, but the trade is beginning to wonder whether a rise, even of modest dimensions, is after all a possibility. Recently we have seen the wire-bar quotation up to £37 and standard within a few shillings of £34, but at that level there were very free offerings from America and a setback resulted. On the other hand, with electro below £36 buyers become quite enthusiastic, and this is always the signal for speculative buying of warrants.

Perhaps the nearest approach to a correct summing up of the copper situation to-day would be to say that the metal is *nearly* ripe for a rise, evidence of this being forthcoming in the remarkable stability of the market during the present year and the frequent spasmodic attempts at improvement. The uncertainty attaching to tin and the unhappy state of spelter and lead have no doubt been instrumental in transferring speculative interest to copper, and on one or two occasions this year the weekly turnover in the warrant market has shown clearly enough that speculative buying was present. This renewal of interest in the red metal and the maintenance of a higher average weekly turnover is extremely encouraging and bodes well for the future.

With Germany only an intermittent buyer and political and financial difficulties in other European countries it is probably useless to expect much appreciation in the price of copper during the next few weeks, but these matters will be resolved one way or another, and whatever the solution prove to be, whether peace or war, it looks as if the demand for copper will go up and the price should move in sympathy.

Sterling Manufacturing Company and Cronite.—We regret that an obvious misprint appeared in an article which gave the nickel content in Cronite as 7 instead of 67 per cent.

Alloys in the Iron Foundry*

By J. Roxburgh

Since the days of the introduction of that misnomer "semi-steel," practically the first definite attempt to improve the properties of cast iron, efforts have been continuously devoted to that end, resulting in the development of alloy cast iron, a definite advancement and one still pregnant with distinct possibilities for the wider application of cast iron.

Undoubtedly, a great deal of literature in this connection has been published, and many results of research work carried out by investigators, both at home and abroad, have been made available to the industry; yet, very often, the practical details of the foundry practice and conditions involved have not been given the attention they rightly deserve.

It is granted that, generally speaking, it is difficult to specify an analysis for a casting to be used for a definite purpose under known conditions, but, having settled that important issue, it is entirely another matter to produce such a casting, sound, free from warp, of the right dimensions and of correct alloy content and analysis.

Sometimes there is a prevalent tendency to believe that alloys are a cure for all ills, but, personally, where possible, the author endeavours to get the most out of ordinary irons and only resorts to the use of alloys where special circumstances demand it. When all is said and done alloy irons are more expensive, and it has been found, in some cases, that a mixture of specially-selected irons and scrap has given results comparable, in so far as tensile, transverse and Brinell figures are concerned. Again, although it might disturb the scientist, the author has actually made castings to resist abrasion from a mixture of steel scrap and "burnt" iron, which, it will be agreed, is a very cheap mixture indeed. This particular instance is cited with the object of advising founders to go as far as they can with ordinary irons before incurring the expense of alloy irons. Perhaps, too, the founder might have been able to correct some fault in a certain casting by the use of alloys, but that is not to say that, if he had had the necessary fundamental knowledge, he could not have achieved the same result in some other way. It should not be thought, however, that any attempt is being made to decry the use of alloys. Far from it! There is a definite place for them in the foundry industry.

It is of paramount importance, at this stage, to emphasise the fact that it is essential for the producer to be cognisant of all the details regarding the conditions of service of a casting before any attempt is made to specify a suitable analysis or mixture. With this end in view, it is really unnecessary to mention that the closest co-operation should be maintained between customer and supplier, especially in the initial stages.

Heat-Resisting Irons

In this connection, take, for instance, the heat-resisting irons. The working temperature should be stated, whether maintained at this temperature for short periods or continuously, the atmosphere whether oxidising or reducing or whether gas-laden containing sulphur or its compounds, or whether the casting is subject to any corrosive action due to acids or liquors simultaneously. At the same time, the strength properties at normal and elevated temperatures must be given consideration, as it is known that some good heat-resisting irons lack strength, and so other types having the necessary strength must be used.

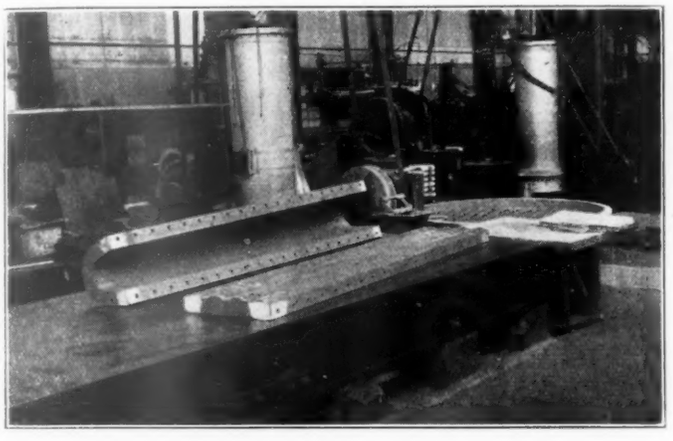


Fig. 1.—Chrome Heat-Resisting Castings to Withstand 650 deg. C., shown Machined.

It is generally assumed that irons containing low total carbon, under most conditions, are better for heat resisting, as the graphite is in a finer form, thereby eliminating the channels, which are present in irons with large graphite flakes, along which oxidation can take place. On the other hand, however, sight must not be lost of those castings which are liable to oxidation, growth and subsequent cracking due to the drastic treatment to which they are subjected, *e.g.*, ingot moulds, which, in the majority of cases, are made with hematite containing high total carbon, low combined carbon and large graphite flakes. The elevated temperature of the surfaces in contact with the steel, the expansion and contraction of the mould, demand that the casting should possess, for want of a better term, that elasticity to take care of the strains. It will have been noticed that the surface of the mould after a number of casts begins to show that "crocodile" appearance. It is postulated that, with a mould containing low total carbon, it would fail prematurely due to cracking. The author once made an ingot mould, for experiment, from the air furnace with a hematite base, the resultant total carbon being 3 per cent., and found that, after only two or three casts, it was of no further use due to cracking.

Again, the author experimented on somewhat similar lines, only this time with a semi-steel mixture from the cupola, with a 12-in. dia. chill, 6 in. thick for a chilled roll, and found that after five casts, to be precise, that it had cracked beyond further utility. Sometimes, with preconceived ideas, founders are liable to a rude awakening.

The conditions of service, too, are important with regard to the wear- and abrasion-resisting castings, and often it is a question of obtaining a higher hardness value and uniformity of structure to obtain an enhanced life. Sometimes the author has found that, having prepared an iron solely to resist abrasion, only after actual service has it been discovered that corrosion also is taking place due to the presence of some liquor, and so an alteration had to be made in subsequent castings in an endeavour to counteract this.

Therefore, although perhaps it may seem unnecessary to stress the point, it is obvious that the producer should be in possession of all the facts relating to the service of the casting, before ever attempting to manufacture, or even indicate, the most suitable metal.

Having decided that for these special purposes the casting should contain a certain percentage of alloy or alloys, inquiry is made as to the form in which the various alloys are available to the foundry and as to the various methods of addition. It is well known that the alloy can be supplied as a ferro-alloy, as pure ingot, as shot or in powder form or briquettes. On the other hand, special synthetic pig-irons, to specification, can be purchased from reputable firms willing to guarantee the analysis. Knowing that, in some cases, the alloys can be obtained in any of the above forms, it is often perplexing, without previous experience, to know whether it is wisest to make ladle additions in certain cases or to add direct to the furnace available or to make use of the special pig-iron previously mentioned. Naturally, the melting point of the alloy, the temperature obtained in the ladle or furnace, the degree of accuracy of control of the metal desired, and, in these days particularly, the comparative extra cost of the alloy addition, by whatever means, are all points to be considered before arriving at any decision.

At this juncture, therefore, it would be advisable to consider the various melting units in general use to-day in conjunction with these alloy additions. The cupola suggests itself for primary consideration as probably it is the most common type of furnace used.

Introduction of Chromium

In connection with the cupola, the introduction of chromium will be considered first. It is known that this element can be added as ferro-chrome, containing up to 70 to 80 per cent. Cr as desired, and from carbon-free up to 8 to 10 per cent., and again as chromium briquettes, usually containing little or no carbon. The ferro-alloy is added in lumps and, owing to the high

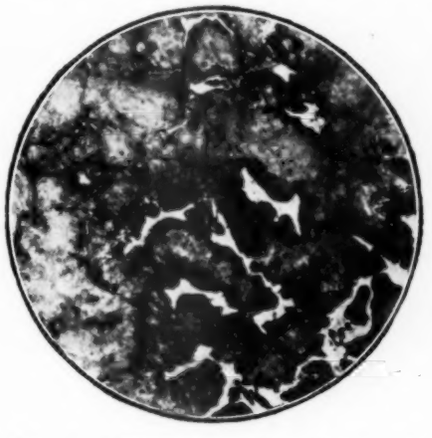


Fig. 2.—Microstructure of Metal for Castings in Fig. 1. × 100.

* A Paper presented to the Sheffield Branch of the Institute of British Foundrymen. Mr. W. T. Kitching presiding.

melting point of the alloy, approximately 1,580 deg. C., which is lowered with increasing carbon, it is somewhat difficult to obtain complete liquefaction, which might lead to the occurrence of hard spots in the casting, and there is also to be taken into account the appreciable loss by oxidation. In the usual commercial grades of ferro-chrome, the chromium for the greater part is already present in the carbide form and, consequently, it is difficult to melt, and variable results are liable to be obtained. However, owing to circumstances, the jobbing founder often has to resort to this method for adding chromium, but with good cupola practice and laboratory control it is surprising how satisfactory are the results obtained.

The importance of obtaining hot metal when dealing with alloy metal must be stressed, and generally the author would make sure that the coke bed was well burnt to ensure a hot hearth, and would put extra coke in the separating charges. The resulting hot metal can then the more readily be dealt with, and especially if chill tests are taken, when the metal has to stand at least ¼ hr. and longer if the depth of chill has to be adjusted by the addition of soft metal.

With chromium briquettes, containing little carbon, liquefaction takes place more readily and rapidly, owing to their lower melting point. These briquettes yield their chromium to the molten iron without absorption of carbon and with practically no loss. Unfortunately these briquettes are expensive, but recently a firm has commenced making briquettes with 4 to 6 per cent. C at the same price as ferro-chrome. The addition of powdered ferro-chrome to the ladle should not be encouraged, although, probably, some foundries still adhere to this practice when dealing with smaller additions. The author strongly recommends those foundries not having the services of a chemist or laboratory to use synthetic pig-irons, which probably make the resultant iron dearer, but which, under such circumstances, would prove cheaper in the long run.

Addition of Nickel

Regarding nickel, this can be added to the cupola in the form of Ni ingot or sheet and approximately 2½ per cent. loss should be allowed for. In the main, the results obtained with sand castings are fairly reliable, although the high melting point of this element again militates against obtaining complete liquefaction and satisfactory distribution in the metal. Provided that there is sufficient metal to be run into a ladle, the "F" nickel shot can be added down the spout. This shot has a lower melting point, approximately 1,260 deg. C., and contains 92 per cent. Ni and about 6 to 8 per cent. Si. This method has given in practice fairly consistent and satisfactory results. With reference to molybdenum, this is available as ferro-molybdenum, containing 80 per cent. Mo, and no loss should be allowed on melting. The author has found from experience that it is essential to melt iron containing Mo, twice or even three times before uniformity of analysis and structure is obtained.

The author strongly advocates that before pouring alloy irons they be boiled up with a "robbler," made by fixing a piece of wood in the end of a long tube, which is simply inserted in the metal, and, by this means, a correct mixing is obtained.

Further complications arise with cupola melting, however, and the most meticulous care is required if good results are desired. Owing to the character of its work, the requirements of alloy iron in a jobbing foundry vary from day to day. Some days it might be only a case of 10 cwts. required, other days 1 or 2 tons, whilst another possibility is that of 3 or 4 tons, or even more, containing varying amounts of alloy or alloys on the same blow. All these possibilities create their own difficulties. In any case, if possible, the special iron should be put on first and charged in excess of requirements to avoid contamination of iron following. It is always possible to pour the extra down and make useful scrap, or arrange for the extra to be mixed with the iron following and put in some suitable casting. Great care, too, must be exercised with the order of charging, and the ferro-alloys should be added with the first charge so that the further charges comprising the mixture will bring down the alloy into the correct ladle. If the price obtained for the castings warrants it, it is much easier, from a control point of view, to buy special pig-irons. With two meltings, also, the metal is rendered more uniform. In this connection, where possible, it pays a founder to consider the manufacture of his own iron by either running down initially from the cupola into pigs, when probably it would be necessary to desulphurise, or, better still, from his air furnace, where no sulphur gain is registered and where he can obtain a low total carbon, to allow for the carbon pick-up on remelting in the cupola.

Air and Rotary Furnaces

In an air furnace, of course, the bath of molten metal is not in contact with the fuel and

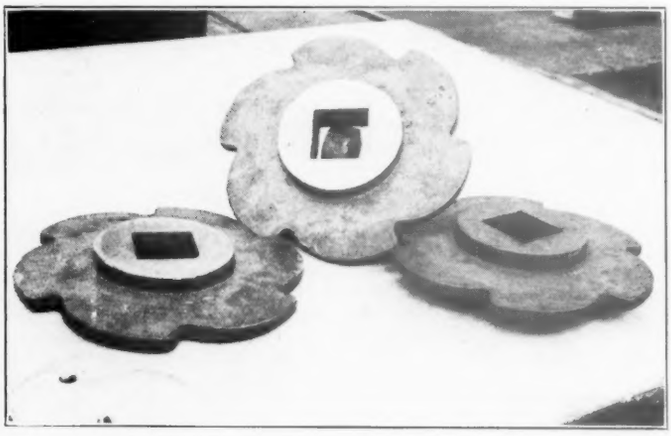


FIG. 3.—CHILLED CHROME COKE SCREEN DISCS.

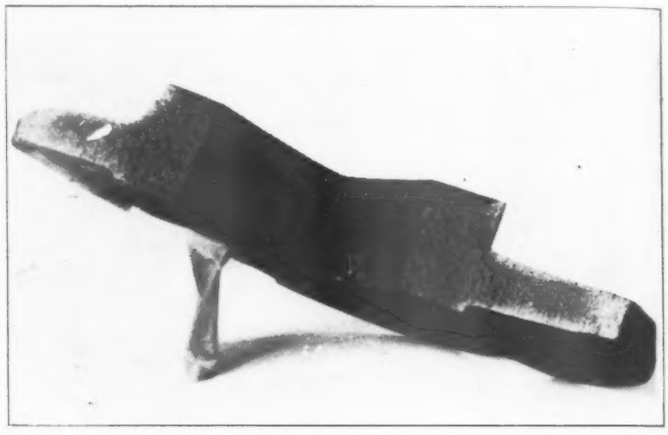


FIG. 4.—FRACTURE OF BROKEN CHILLED SCREEN DISC.

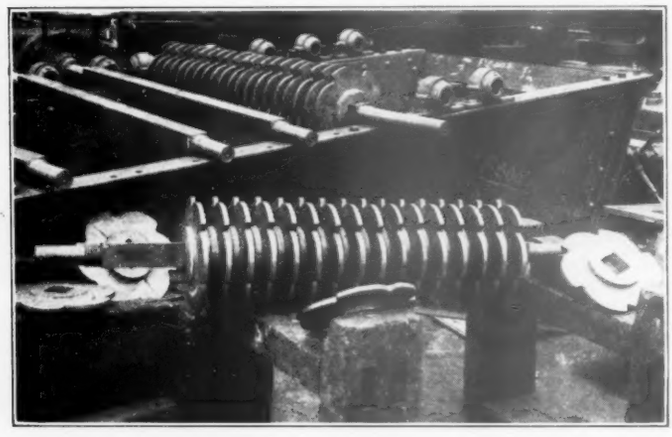


FIG. 5.—ASSEMBLY OF CHILLED SCREEN DISCS ON SHAFT.

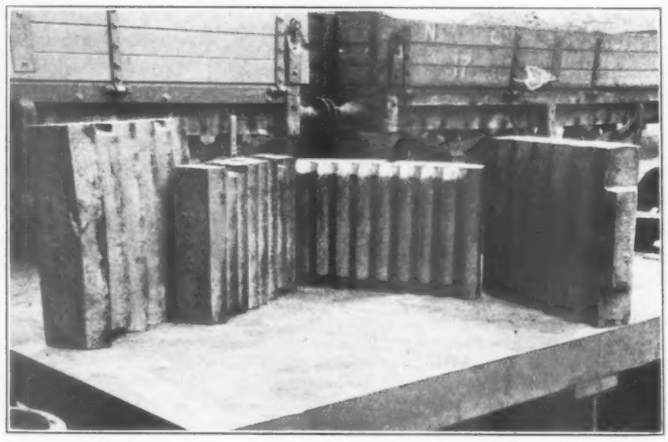


FIG. 6.—CHILLED CRUSHER JAWS IN ALLOY IRON.

oxidation of the various elements in the iron takes place. Now, without previous experience, it is a problem to know when to add the alloy or alloys, *i.e.*, at what suitable stage of melting, and so, if we take ferro-chrome, for example, you will find that it is advisable to add this alloy to the bath a few hours before all the metal is actually in a molten condition, the time, of course, depending on the weight of alloy to be added. For instance, 2 cwts. of ferro-chrome should be added to 10 tons of metal 3 hrs. before you consider the metal will be all melted. Even in this type of furnace the temperature obtained is not really sufficiently high to ensure the best melting conditions for the complete liquefaction of the ferro-chrome, but better results are obtained in this respect than in the cupola. Ferro-molybdenum and nickel ingot should be added with the charge, and practically no loss allowed for. Fairly consistent results have been obtained with the various alloys in the air furnace up to percentages round about 1 to 1.5 per cent.

Of course, with the advent of the rotary furnace, alloys can be dealt with still more successfully, as the temperature obtained is much higher. In the case of chromium, it can be added in the form of lump ferro-chrome, 60 to 70 per cent. Cr and 2 to 4 per cent. C, either with

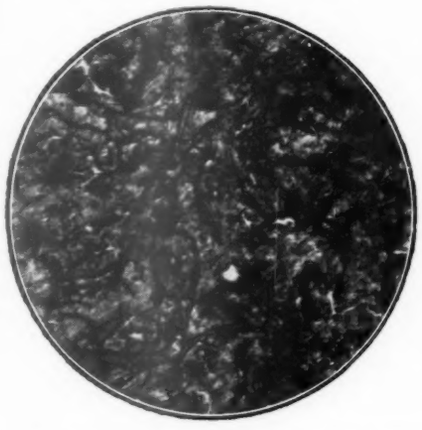


FIG. 7.—MICROSTRUCTURE OF METAL CONTAINING 50 PER CENT. HEMATITE AND ALLOY FREE. × 100.

the cold charge or when the charge is just becoming soft. Possibly the latter is the better practice, although no appreciable difference is found in the oxidation, which, in both cases, averages 10 to 15 per cent. With 70 per cent. Cr and 6 to 8 per cent. C, the ferro-chrome could be added even ½ hr. before tapping. With regard to nickel, "F" nickel shot is favoured, put in tins containing, say, about 56 lbs. This may be added 25 minutes before tapping, when the bath is quite hot and fluid. It is a definite advantage to have a good fluid slag so that, from the physical point of view, the alloy has no trouble in getting through. Very special alloy irons, *e.g.*, Ni-Resist or Nimol or Nicrosilal are best melted in crucible furnaces, whilst oil-fired furnaces can be used for irons containing 27/30 per cent. Cr. Melting losses in various types of furnaces are shown in Table I.

Chromium Irons

When alloyed with cast iron, Cr forms hard complex carbides and helps to refine the matrix, and for these reasons renders the iron suitable for abrasion- and heat-resisting castings under certain conditions. Again, in order to resist the action of oxidising gases, containing S compounds, high contents either of Cr, Si or Al must be used in the castings. As the carbides are stable, the addition of even small quantities of Cr makes cast iron resistant to the action of heat, and consequently it retains its special qualities at high temperatures. Familiar applications are firebars, furnace parts, retorts, annealing pots, etc.

Where temperatures are maintained for long periods and growth is likely to occur, an iron with low T.C., low Si, commensurate, of course, with the section of the casting and the Cr content, will withstand temperatures up to, say, 800 deg. C. Where Cr is alloyed by itself, machining must be considered, *i.e.*, the percentage of Cr and Si, and section of metal, should be correlated. Personal experience is that 3.1/3.2 per cent. T.C., 1.2 per cent. Si can be used, for instance, with 0.7 per cent. Cr maximum on 1-in. section and still permit of machining at 25 ft. per min. with a high-speed tool. It is remarkable the effect that coke exerts on cast iron with regard to abrasion, and so many applications of cast iron are found containing Cr in this direction, *e.g.*, coke-shute plates, liner plates for coke-oven cars, coke-screening castings, etc. Very often in coke-oven plant, too, there is the dual action of abrasion and corrosion from the tarry liquors.

With chilled surfaces Cr increases the shore hardness and therefore, unless cracking occurs prematurely, gives increased service. In the attempt to avoid cracking with chilled surfaces, it is advisable to keep the Cr content at 0.4 per cent. maximum. Cr also tends to prevent the loss of chill from the test-piece to the casting.

TABLE I.—*Typical Melting Losses and Gains in Various Melting Units.*

	T.C.	Si.	Mn.	S.	Ni.	Cr.	Mo.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Cupola	+ 5–10	— 10–15	— 25	+ 0.030	— 2½	— 25	Nil
Air furnace	— 10–15	— 25	— 25–30	+ 0.010	— 2½	— 20	Nil
Sesci rotary	— 5–10	— 10	— 10	+ 0.020	—	— 10–15	Nil

Chilled Cr-Alloy Rolls

Chilled Cr-alloy cast-iron rolls have now been some time in fashion, and the most common type is the Cr-Mo, where longer service is claimed and a stronger roll obtained. In the early days variable results were obtained, but some success has undoubtedly accrued since. With regard to grain rolls, containing low T.C. and cast from the air furnace, it has been customary for a long time to introduce 0.5 per cent. Cr, and doubtless the combination of the two, *i.e.*, low T.C. for strength and Cr for wear, gives a splendid roll. Nickel is often alloyed along with Cr in cast iron and gives improved strength, wearing properties and often good heat-resisting properties. The authorities generally recommend the addition of Ni of three times the Cr content. Ni-Cr alloys have a wide application for motor-car components such as cylinders and cylinder heads. Additions of nickel help to improve the quality of cast iron, by refining the grain and making unequal sections more uniform in structure. It eliminates hard spots, thereby assisting ease of machining, and by ensuring a closer-grained iron improves pressure tightness and also increases resistance to wear and temperature. Generally, the silicon is lowered when Ni is added, as Ni acts similarly to Si, only precipitating the graphite in a finer state of division. However, in an atmosphere containing S or its compounds, Ni should be avoided owing to the formation of Ni S at comparatively low temperatures. Additions of Ni up to 5 per cent. give an iron containing a pearlitic matrix, whilst between 5 and 15 per cent. it becomes mainly martensitic and great hardness is obtained. Above 15 per cent. approx. the irons are completely austenitic. The austenitic irons are practically non-magnetic, and with 10 per cent. Ni and 5 per cent. Mn the well-known Nomag is obtained, whilst Ni-Resist and Nicrosilal are other examples of austenitic irons.

Effect of Molybdenum

The addition of Mo to cast iron produces a more uniform distribution of the graphite, with consequent refinement of the structure. It also toughens the matrix and retards grain growth. It is claimed to increase the tensile, transverse and Brinell, yet not enough is known of the effect of this element on cast iron and further developments must be awaited. At any rate it is an expensive element and should only be used in very special cases. Brake drums are made in America with 0.2/0.4 per cent. Mo, whilst certain castings, with which the author has come in contact, have contained as much as 2 per cent. It is said that 0.20 per cent. Mo to an ingot mould increases the life given. Mo is now used for quite a number of chilled rolls, *e.g.*, strip and sheet rolls, and claims are made for increased service, less breakage, less frequent dressing and a better finish on the rolled products. With some rolls Ni, Cr and Mo are alloyed together.

For a long time the effect of manganese on cast iron seems to have fallen into the background, and one is apt to neglect the importance of addition of high Mn from the point of

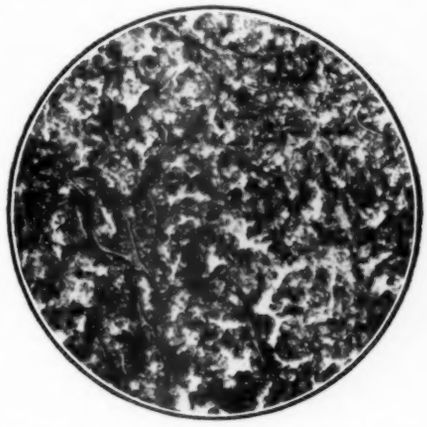


FIG. 8.—MICROSTRUCTURE OF SIMILAR METAL WITH ADDITION OF 0.3 PER CENT. CR AND 1 PER CENT. NI. × 100.

view of heat resisting and hardness. Take, for instance, ingot moulds. Some experiments conducted on small moulds indicated that between 1.5 and 2 per cent. Mn there was an optimum content, which gave the best results in service. Again, with chilled safe plates, a high T.C., about 3.8 per cent., a Mn, in the region of 1.2 per cent., with low S, effectively resisted the blowpipe and drill of the burglar. Mn, again about 1 per cent., gives the founder the necessary medium whereby with a fairly low T.C. he can obtain Brinell hardnesses of the order of 200 to 220, demanded on slide faces by the machine-tool maker. It will be noticed, too, that Mn is specified about 1 per cent. in most of the well-known special irons, *e.g.*, Ni-Resist and Nicrosilal. With sugar rolls, where a rough surface is required to grip the sugar canes, 5 to 6 per cent. Mn is incorporated to ensure a coarse grain. However, on the other hand, a high Mn chill, obtained on chilled rolls, does not give as good results as a roll containing low Mn content.

In the control of alloy irons, the chill test is invaluable in the foundry, as the depth of chill thrown on such a test indicates approximately the balance of the various constituents, and it is especially helpful in the case of castings which have to be machined, when, from experience, one can find a definite maximum chill for ease of machining.

(*Concluded on page* 338.)

Potentialities of Cast Iron

RECENT RESEARCHES OPEN UP FRESH AVENUES OF APPLICATION

(*Concluded from page 322.*)

DISCUSSION ON MR. HUNT'S PAPER

Automobile Crankcases

Dr. A. B. Everest, opening the discussion, supported the general truth expressed in the Paper that the future of cast iron lay in greater co-operation between the casting designer and the foundryman, and the basis of this co-operation should be a better understanding of the properties and characteristics of cast iron. Recently he had been very much impressed by some of the evidence throughout the country that cast iron was being better appreciated and was gaining ground in competition with much more expensive alloys. This was particularly true in the case of castings for automobiles, and he had been amazed to find to what extent cast iron was replacing aluminium in the case of firms even who were interested in both the cast iron and aluminium sides of the business, the loss of work on the aluminium side being balanced by the increase in the number of iron castings.

A definite example of this was to be found in connection with automobile crankcases. At one time it was the vogue to use aluminium crankcases on top of which the cast-iron cylinder block was bolted. By reason, however, of improved technique in the iron foundry, better understanding of the properties of cast iron and close co-operation between the designer and the foundrymen, a better job was now being produced in which the crankcase was cast integrally with the cylinder block, the whole, of course, being in cast iron. He thought that Mr. Hunt would support him in stating that this was the general tendency in the automobile industry.

Locomotive Cylinders

Another example is to be found in connection with locomotive cylinders where distinct progress has been made as a result of co-operation between engineers, designers and foundrymen. In olden days there was plenty of evidence both in literature and in practice of considerable trouble in making good locomotive cylinder castings. In discussing this matter, however, with one of the oldest established makers in the country, he, the speaker, had recently found that little or no difficulty was experienced in making locomotive cylinders to-day. Previously the cylinder was designed to operate with a slide valve, which resulted in ports of complicated and twisted shapes, largely because the valve mechanism was small in relation to the size of the cylinders. The tendency to-day was to use the piston valve instead of the old slide valve, this consisting of a long dummy piston sliding in a small cylinder above the main cylinder, the ports connecting the two being thereby straightened and simplified, thus eliminating many of the points of special difficulty for the foundryman. This could certainly be put forward as an example in which the change in design carried out with the full understanding of the foundryman's difficulties had resulted in an easier job for the foundryman and more reliable and more satisfactory results generally.

Controlled Compositions and Elimination of Alloys

Mr. J. N. Burns suggested that too much stress was being laid nowadays on the addition of nickel chromium, etc., to irons. He believed that for general foundry work, especially as related to the automobile industry, entirely satisfactory results can be obtained without the use of these elements, providing the product is manufactured under careful metallurgical control both in the foundry and subsequent heat-treatment. He believed that several American automobile manufacturers have produced thousands of crankshafts securing high strength in the castings, excellent surface, and high wearing qualities. It appeared that cast iron both grey and malleable was entering more and more into the field of forgings; one company was definitely eliminating difficult and even simple forgings and using in their stead various types of irons, and was further endeavouring to eliminate the alloying elements and yet maintain the strength and other properties of the irons purely by control of the carbon, silicon, phosphorus, etc., and further by careful heat-treatment. Production, for instance, of malleable iron castings having a tensile strength of 31 tons per sq. in. and about 20 per cent. elongation are to-day an established fact.

Educating the Buyer

Mr. R. B. Templeton, discussing co-operation, said it was very difficult to get the average buyer of castings to appreciate all the advances which the foundryman had made. The problem of price also entered into the discussion very much. Apart from exceptional cases, buyers would say that they had no need for a very high tensile or very high grade casting, or that their machines had been designed on certain sections for years; and it was very difficult to persuade them to change. The foundryman, therefore, should do his utmost to ensure that the designer did appreciate the advances that had been effected in cast iron.

Mr. Templeton did not quite agree with the remarks of Mr. Burns concerning the addition of nickel, etc., because in his experience nickel was of definite advantage in increasing the strength of iron. The tensile strength of irons which would normally be of about 25 tons tensile, for instance, could be increased by an addition of 1 per cent. of nickel; the increase of strength might not be more than perhaps 10 per cent., but it was a definite increase. At the same time, such additions were not always necessary. For instance, he did not add nickel or chromium when making camshafts, and very satisfactory tests had been obtained with camshafts made of a straight inoculated iron; the cams were just chilled, and the Brinell figure was about 450.

Mr. J. N. Burns said he did not wish to suggest that addition of chromium and nickel were not advantageous, but had in mind particularly the economic aspect; both nickel and chromium were expensive, and if one used 2 or 3 per cent. of such additions in an output of 20 or 30 tons per day they represented a very heavy expense. If one could secure the desired properties by controlling the elements already in the iron, one was better able to compete against forgings than one could if expensive alloying elements were incorporated.

Modulus of Elasticity

Mr. Wesley Lambert, C.B.E. (Past-President of the Institute), was particularly interested in the author's reference to the relatively high modulus of elasticity of cast iron, because only very occasionally was this important property of cast iron mentioned at foundrymen's meetings. If, he said, a ton weight, for example, was suspended at the end of a bar of cast iron of a given cross sectional area, the bar would elastically stretch a slight amount, but on removal of the load the bar would recover its original length. From the amount of stretch observed, one can proceed to calculate the load per sq. in. which would be required to stretch elastically the bar to double its length, assuming such an imaginary happening to be possible; the figure resulting from this calculation represents the modulus of elasticity of the metal under tension. Similarly, an observation of the elastic shortening effected by a comparatively low compression stress on the surface of a prepared specimen, enables one to calculate the compression load per sq. in. which will produce an imaginary elastic shortening to half the normal length of the specimen; this figure represents the modulus of elasticity of the material under compression.

At one time, it was not unusual for designers to base their designs on the modulus of elasticity of the metals employed. Nowadays, designing on the basis of the elastic limit or the tensile strength seemed more usual. Mr. Lambert asserted, however, that designers were not strictly justified in departing from the older practice. It did not necessarily follow that a metal of a slightly higher tensile strength than another had a correspondingly higher modulus of elasticity. On the contrary, comparative tests between, for example, an ordinary straight carbon steel, of round about 35 tons tensile, and a similar steel containing 3½ per cent. of nickel, may show the latter to have a lower modulus, notwithstanding that the former may have a lower tensile strength. The nickel steel being more elastic—by virtue of the introduction of nickel—may stretch more for a given load than does the straight carbon steel.

Mr. Lambert said he could comprehend the advisability of the replacement, in the automobile industry, of certain aluminium castings by cast iron. Apart from questions of founding, cast iron was very robust and comparatively more rigid than some metals used in engineering design. Its elastic distortion was not so easily effected, and under conditions appertaining in automobile service this property doubtless was beginning to be more recognised. He had not made determinations of the modulus of nickel cast irons. True, high tensile figures were obtainable by the introduction of nickel to cast iron, but he would not be surprised to hear that the modulus figures were lower than one might expect. He asked whether Dr. Everest could give any information regarding the comparative figures of the modulus of elasticity of similar cast irons, with and without nickel additions.

Alloying and Duplexing

Dr. Everest, replying to Mr. Lambert, said he did not know whether he had any figures available concerning the modulus of elasticity of nickel cast irons, but he would look into the matter and would be glad to pass on any relevant information.

Commenting on the remarks of Mr. Burns concerning the production of high strength cast iron by proper control of composition and by heat-treatment instead of by using nickel, he asked if some of the irons referred to by Mr. Burns were not made under special conditions, as, for example, in the electrical furnace, and whether they were not subsequently subjected to special expensive treatment. If, as he suspected, these castings were made under these special conditions, then it was necessary to take these conditions into account in considering the expense of using nickel, and, once again, he would like to restate that in certain classes of work no claim was made that nickel was the only way of getting the results, but it was put forward as a simple and ready means of obtaining reliability and avoiding some of the foundry troubles when they were liable to occur.

Mr. Burns replied he believed that in America the methods employed for producing

these unalloyed irons were the duplex process, the ordinary air furnace, and later the rotary furnace. The irons produced by these methods were certainly cheaper than alloyed irons. The cost of the heat-treatment is also comparatively low. It was generally found that the heat-treatments were of great use, apart from the metallurgical aspect, as machining was greatly simplified, and yet the high strength and wearing qualities were obtained.

Mr. V. C. Faulkner (Past-President of the Institute) pointed to the phosphorus contents of the irons referred to in the Paper, and said he supposed Mr. Hunt had had in mind only engineering irons and not the quality of castings such as were used in sanitary work and the like.

AUTHOR'S REPLY

Mr. Hunt, replying to the discussion, welcomed Dr. Everest's confirmation of the point made in the Paper concerning the decreasing use of aluminium and magnesium alloys. It had been a hobby horse of his for some time, though he had been contradicted by people who were interested in the light alloy; but it was a fact that makers of other than high-priced motor cars were losing interest in light alloys to a great extent, and in one case at any rate the monobloc cylinder casting, which was very rigid, of course, had come back to stay. That remark applied also to the head in many cases.

Commenting upon Mr. Burns' criticism, Mr. Hunt recalled a statement made in the Paper, that "The straight silicon irons seem to be quite capable of development for many structural purposes, and whilst the use of molybdenum, vanadium and titanium for the purpose of grain refinement is slowly spreading, here again there would appear to be no real obstacle to the production of straight irons with equivalent structure and properties provided the cooling conditions were under careful control." He had in mind the economic aspect of the problem. Again, he recalled that in the course of a previous discussion Mr. Kain had remarked that the straight silicon irons had not yet reached their greatest achievements. He assured Mr. Burns that he did not intend to stress in the Paper the use of nickel and chromium.

It was true, as Mr. Templeton had pointed out, that it was difficult to convince a buyer of the facts, and that was a factor which stood in the way of developments.

The modulus of elasticity of cast iron, although a variable factor, was dependent on composition; on the other hand, the modulus of steel was to all intents and purposes a constant factor, at 30 million lbs.

In reply to Mr. Faulkner, he said the castings referred to in the Paper were certainly for engineering purposes, to meet more or less severe stresses.

Vote of Thanks

Mr. A. S. Beech (Branch-President-Elect), proposing a vote of thanks to the authors of the five Papers presented, commented on the variety of the subjects, and said he had been amazed by the skill with which the authors had compressed so much information into a small space.

Mr. F. O. Blackwell (Branch Vice-President), seconding, referred to the very high standard of the Papers, and said they had raised the prestige of the London Branch very considerably. It seemed that the tendency would be for the engineering castings to develop on lines of specialisation. If a maker of other classes of products attempted to manufacture a cylinder block he would produce a waster, whereas if a maker of cylinder blocks were asked to make a rain pipe or a gutter it would possibly turn out somewhat like a corkscrew. By specialisation the foundry trade would undoubtedly develop most rapidly.

The vote of thanks was carried with acclamation.

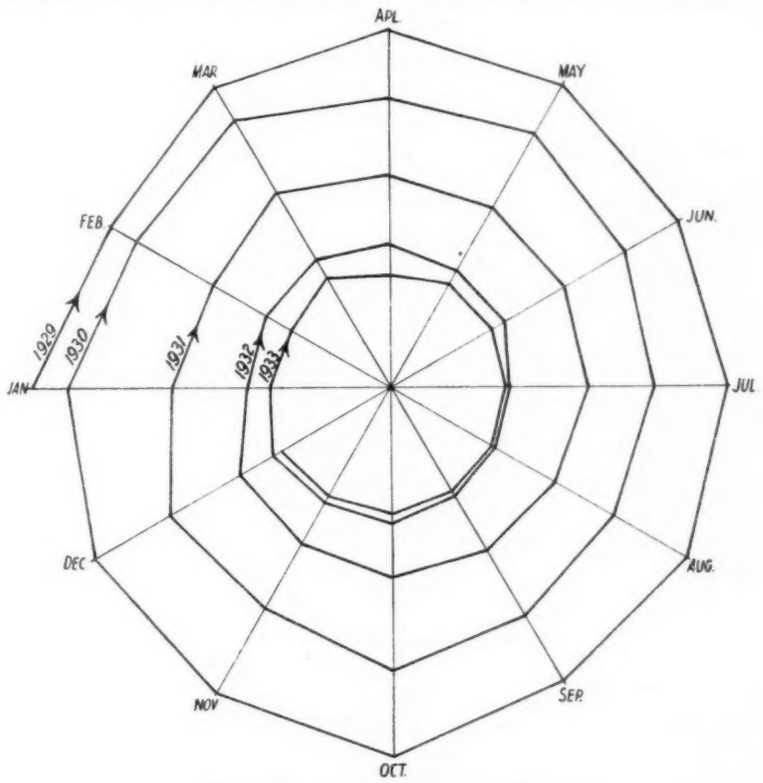
Mr. V. Delport took the opportunity, at this the last meeting of the session, to thank Mr. C. H. Kain for his conduct of the Branch affairs as President, and to congratulate him upon the success achieved. The Papers read during the session had been of very high class. The members looked forward to his continued interest in the work of the Branch in future years.

The vote of thanks was heartily accorded.

The Branch-President, responding, assured the members that he had thoroughly enjoyed his work as Branch-President, and expressed the hope that his successors would find the work equally interesting and enjoyable.

Contracting Spiral of World Trade

The annual report and balance sheet of Imperial & International Communications, Limited includes the accompanying very interesting diagram showing in a most illuminating form the progressive contraction of world trade from January, 1929, to December, 1933. It is constructed from monthly indices based on total values in terms of gold dollars of special imports and exports of 73 countries, 1929 = 100. The diagram is reproduced with acknowledgments from "World Economic Survey, 1932-33," published by the League of Nations, and brought up to date from figures (provisional in 1933) given in the "Monthly Bulletin of Statistics" Nos. 1 and 3, 1934.



Contracting Spiral of World Trade.

Catalogues Received

Refractory Patching Materials. A six-page folder sent to us by Messrs. John G. Stein & Company, Limited, Bonnybridge, Scotland, outlines the properties and directions for using Maksiccar I Fire Cement, Maksiccar II Refractory Cement, Maksiccar Patch and Stein Patch. The whole question of "patchings" for cupola work is at present being studied by the technical authorities of the foundry and refractory industries, and this folder should be sent for by those in control of furnaces.

Alloys. A 24-page well-illustrated catalogue, received from Wild-Barfield Electric Furnaces, Limited, of Elecfurn Works, North Road, London, N.7, gives a mass of technical data relating to Telcon electric-resistance alloys manufactured by the Telegraph Construction & Maintenance Company, Limited, and marketed throughout the world by the senders. The brands specially dealt with are "Pyromic" and "Calomic," and the data set out are well worth while studying and filing for future reference.

Book Review

Notes on Concrete Construction and the Principles of Design in Reinforced Concrete. Written for Ketton Portland Cement Company, Limited, London and Sheffield, 1934. Published by Sir W. C. Leng & Company (Sheffield Telegraph), Limited. Price 7s. 6d. net.

This book deals in an elementary way with the construction and design of concrete structures. Although only simple mathematics have been employed, the designs of comparatively complex structures have been worked out in great detail and completely illustrated. The diagrams are particularly understandable, and the whole of the book has been well arranged and printed. The publication is, however, little more than a student's elementary hand-book, and the author is wise in pointing out in the introduction that before the design of any reinforced concrete of considerable magnitude is undertaken, the advice of an experienced engineer or architect should be obtained. J. F. K.

Scottish Branch Annual General Meeting

The annual general meeting of the Branch was held in the Royal Technical College, Glasgow, Mr. J. Currie, Branch-President, in the chair. The secretary presented the annual report on the work of the session, a synopsis of which is given below.

Annual Report

The increase of 16 in membership compares favourably with last year, when there was a decrease of 15, but the net result is to leave our membership only one better than it was two years ago.

This year it has been possible to have only six regular meetings of the Branch in Glasgow, held on the second Saturday of each month. The attendance at the Edinburgh meetings was not quite up to the figures of last year, but this was partly due to powerful counter-attractions, which, on at least one occasion, could hardly be other than irresistible to an Edinburgh man. These meetings, however, are still in the nature of propaganda meetings, and we are hoping for better results to follow. The thanks of the Branch are due to Mr. William Wallace, the local chairman, and his committee for the good work they are doing. Good work is also being done by the Falkirk Section, under the presidency of Mr. Thomas Shanks. We are sorry that Mr. Morrison has had to resign his office as secretary, but as this follows upon his removal to London to take up a position of greater responsibility for his firm, we must not grumble. Instead, we congratulate him on his appointment, thank him for what he has done, and turn round to welcome Mr. McNair, of Bonnybridge, who succeeds him. We are looking forward to better times in Falkirk, and hope that during Mr. McNair's secretaryship these may be realised. Certainly, in view of the extensive foundry interests in this area, we feel that the Section should be much better supported than it is.

As usual, the syllabus was compiled on fairly broad lines. In an institute such as ours, where many varied interests are represented, it is not always easy to secure a just balance of these interests. Members employed exclusively in the founding of cast iron, steel, or non-ferrous metals each look for something in their own special department. The claims of the engineer, the patternmaker, the metallurgist, and the moulder have all to be considered, and if these are not met so fully as might be wished, it is hoped that the difficulty of doing so will be realised. This is particularly so in the case of the practical moulder, and any offers of practical Papers will be gladly welcomed. This is always a difficult part of the syllabus to fill.

An interesting feature of the syllabus was the joint meeting with the Institution of Mechanical Engineers and the West of Scotland Iron and Steel Institute, which was held on March 1. It is appropriate that Mr. Currie, the President, is a steel-foundry man, and to him and to our other members who took part in that meeting we owe a special word of praise.

It is satisfactory to be able to record this year again that one of our members has been awarded a diploma for a Paper read before the Branch. On this occasion the diploma was given to Mr. Robert Ballantine for his Paper on "Plaster Patterns in General Foundry Practice."

Further honours have come our way, as the General Council, acting on a suggestion from the Branch Council, has appointed Mr. Winterton and the Branch-Secretary to act on the Finance Sub-Committee of the Institute.

Educational Work

The work of the Advisory Committee, which is acting in conjunction with the Education Committee of the Corporation of Glasgow, still goes on. Visits to each of the schools in which foundry classes are held have been paid, and further visits will be made before the end of the session. These visits are having a very good effect, and it is hoped they will result in making the classes more widely known and more largely attended. This is the aim of the Director of Education, of the teachers, and of the Branch Council alike. It is satisfactory to know that the Sir Archibald McInnes Shaw prizes are proving most useful in encouraging all concerned in this work.

Further evidence of the value of this co-operation will be found in the decision come to by the Director of Education whereby Mr. Campion has been requested to give an extension course of lectures on "Foundry Metallurgy." These began on April 9, and two lectures were given each week.

Another result of the Advisory Committee's work was shown in the increased entries for the John Surtees Memorial Junior Examination. On this occasion a record number of entries was received, and while all the entrants did not present themselves at the examination, the number which did so was also a record.

Entries for the Senior Examination were very much as on former occasions. Obviously, everyone cannot win the medals, but it may be encouragement to the unsuccessful to know that the winner of the Gold Medal on this occasion has tried before—and did not succeed. To those who have failed on this occasion, we commend his example and say to them "Try again." To the winners—Mr. Andrew L. Mortimer (Gold Medal) and Mr. John McGregor (Silver Medal)—we give our congratulations.

The social life of the members has been catered for in the usual manner. The social in October and the dinner in December were both well attended, the number at the dinner being a record for the function.

On this occasion, as on former years, the President of the Institute and the general secretary were present at the dinner, and also at the Branch and Council meetings held on the same afternoon. Both expressed their satisfaction with the working of the Branch, and it is to be hoped that the Scottish Branch will long continue to hold its position as one of the most successful in the Institute.

Sectional Activities

MR. D. SHARPE moved the adoption of the Council's and treasurer's reports, and MR. N. MCMANUS, M.B.E., in seconding, said that, as the President of the Branch during the time of the reorganisation of the Falkirk section, he was particularly pleased to see the great progress being made in that section. He wished to include in his motion an expression of thanks to Mr. Shanks, who had carried the section to prosperity once again. He undertook the chairmanship at his request when things were at a low ebb, and it had been mainly due to the enthusiasm with which he attacked the job that Falkirk was now performing such useful work. He suggested the secretary should be instructed to convey the thanks of the Council to Mr. Shanks. The proposal, on being put to the meeting, was carried with acclamation.

The PRESIDENT said that he wished to move a vote of thanks to the Council for their services during the session, and also to express his own thanks for the great assistance which had been given him during his term of office to the members as a whole. The meetings had all been well attended, and many of the discussions had been of much interest. He wished to convey the thanks of the members to Mr. M. Russell, who was, retiring at that time and not eligible for election.

To Assume Office

The election of office-bearers for next session was next proceeded with, and resulted as follows:—

President: Mr. H. Hurst (foundry manager, Messrs. Jas. Howden & Company).

Senior Vice-President: Mr. D. Sharpe (director, Walter Macfarlane & Company).

Junior Vice-President: Mr. F. Hudson (metallurgist, Glenfield & Kennedy).

Members of Council: Messrs. John Gibb (Coltness Iron Company), A. C. Millar (Fullwood Foundry Company), R. S. M. Jeffrey (Cameron & Roberton, Limited) and James McIntyre (Mirrlees Watson Company, Limited).

Representatives to General Council: Messrs. Jas. Affleck, B.Sc., J. W. Donaldson, D.Sc., James MacArthur and N. McManus, M.B.E.

Representatives to Technical Committee: Messrs. A. Campion, F.I.C., and J. W. Donaldson, D.Sc., A.I.C.

Honorary Secretary and Treasurer: Mr. John Bell.

The Royal Technical College

MR. A. CAMPION, in proposing a vote of thanks to the Governors of the Royal Technical College for the provision of accommodation for the meetings, said that they expressed their thanks each year for the excellent provision made for their meetings. Last year they asked the secretary, when transmitting the resolution to the Director of the College, to express the congratulations to Mr. Stockdale on attaining the age at which he was retiring on pension, and the hope that he would be spared for many years to enjoy a well-deserved rest. That day they were at the beginning of a new term of office, and he thought that they would all wish the new director, Sir Arthur Huddleston, every happiness and success in his new post. They were all very much pleased that Sir Arthur had come to their meeting, so that they had an opportunity of meeting him in person. He hoped it would not be the last of their meetings that he would attend, and on behalf of the Branch he could assure Sir Arthur of a cordial welcome at all times.

The CHAIRMAN said he was sure that they were all delighted to welcome Sir Arthur Huddleston amongst them. He had much pleasure in asking Sir Arthur to address them, and to present the gold and silver medals and prizes awarded in the John Surtees competition.

SIR ARTHUR HUDDLESTON said that it was a pleasure to be at a meeting of the Institute of Foundrymen in the College. In regard to the vote of thanks, he would be delighted to convey it to the governors, as they attached the very greatest importance to the close connection between the College and industry. It was a great pleasure to them to give facilities that industrial and technical bodies like the Institute of British Foundrymen should make use of the College, and they hoped that relations would become closer and closer. He congratulated those who had won the prizes in the Surtees examinations, and it was a great pleasure to him to hand out the books and tools. It was a great thing to start life just a little bit ahead of the other fellows, and those who had been able to earn the awards were undoubtedly a bit ahead of their competitors. He hoped they would keep the lead. It meant work, hard work, but it paid and helped them to keep a broad mind when they got older. He hoped that the College might be able to help them in keeping the lead, and they hoped to see some of them two or three nights per week at the evening classes. He thought that the College offered something which would be of considerable assistance to them. They did not want them to attend classes on more than three nights per week, because that tended to give them a wrong outlook and to regard the technical side as the be-all and end-all.

(*Concluded on page* 340.)

Effect of Non-Metallic Nuclei upon the Graphitisation in Cast Iron

HEREDITY IN IRONS

It is well known that, apart from the undissolved graphite particles in the melt, other substances, such as oxides, dissolved gases, silicates and sulphides affect the graphitisation. According to O. von Keil and co-workers,* not all the non-metallic substances which might be present in liquid cast iron cause solidification to take place after the iron-graphite system, but this effect is exerted especially by the iron silicates if they be present in the melt in a submicroscopical state of division (silicate slime). At present it is not yet possible to determine these finely-divided silicates by the chemical analysis; their effect, however, can be indirectly demonstrated by suppressing the formation of one of the two components—ferrous oxide or silica. When silicon-free cast iron is melted in crucibles the material of which contains no silica, the melt deoxidised with aluminium manganese or an aluminium-magnesium alloy and then ferro-silicon added, there are present in the melt only the oxides of the deoxidation agent but no iron silicates, and solidification will take place after the metastable iron-cementite system, the cementite being afterwards decomposed into iron and fine granular graphite. If, on the other hand, a sufficiently high content of ferrous oxide is provided for in the melt before the addition of ferro-silicon by superheating the melt under the admission of air, iron silicate will form on the addition of ferro-silicon and cause solidification to take place after the stable iron-graphite system, more or less coarse acicular graphite being rejected even at lower carbon contents. In ordinary cast iron a more or less high content of silicate slime is always present, part of which comes from the pig iron. In melting down the iron and by the rust of the scrap ferrous oxide is formed which gives rise to the formation of further silicate slime on the addition of silicon or ferro-silicon. To render the silicate innocuous it is either destroyed by a strongly acting deoxidation agent such as magnesium or calcium, or removed from the metal into the slag by superheating the melt.

Nearly all the common alloying elements of cast iron reduce the critical carbon content above which, at a given cooling rate, solidification follows the lines of the stable system. The stimulation of graphitisation is perhaps due to the increased dissociation of the iron carbide in the melt. The effect of the alloying elements is affected by the silicate slime as follows. Strongly dissociated melts such as those of iron-carbon-nickel, iron - carbon - silicon - manganese, and iron-carbon-silicon-nickel, have at a definite silicate content the same critical carbon content at any cooling rate. Increasing the silicate content reduces the critical carbon content. Dissociation and silicate content act, therefore, in the same sense. On the other hand, less-dissociated melts such as iron-carbon-silicon melts, show a critical carbon content which is greatly dependent upon the cooling rate. At cooling rates higher than 25 deg. per min. the silicate slime discontinues to affect the critical carbon content. This different behaviour of silicon-bearing cast iron must, to all probability, be attributed to a radical difference in the action of silicon and most of the other alloying elements. Phosphorus seems to behave like silicon.

Electric Furnace Iron

In melting cast iron in an electric arc furnace of 7.5 tons capacity it was found that the silicate slime content of the molten iron increased with increasing silicon pick-up, the latter being dependent upon the melting time and the composition of the slag used. Under lime-silica-fluorspar slags the gain in silicon was about 0.25 per cent. with a silicon content of the charge of 0.1 per cent. Under a bauxite slag containing 95 per cent. of alumina, the silicon pick-up of the iron was only 0.1 per cent., and under a lime-fluorspar slag a loss in silicon of 0.05 per cent. was found. The method of operation was the same with the three slags. The irons melted under the lime-fluorspar slag showed a transverse strength of from 32 to 37.5 tons per sq. in., compared with an average figure of 25.5 tons per sq. in. obtained with the irons melted under lime-silica-fluorspar slags. The experiments show that by using slags of suitable composition it is possible to get an increase in strength of 6 to 12 ton s per sq. in. without any additional expenditure of time and power.

Chill Rolls are Influenced

In transverse tests made on a charcoal iron, the observation was made that some of the bars exhibited a rim layer of an extremely fine grain size, and with a carbon content higher by about 0.25 per cent. than in the centre portion of the bar. This structure was not affected by remelting the iron several times. When cast in a chill mould, the rim-forming iron showed a greater hardening depth. Further tests on irons of equal composition, but varying silicate-slime content, showed that the irons poor in silicate had the greater hardening depth and a smoother transition from white to grey. From these observations the authors draw the conclusion that the silicate content has a great bearing upon the inherent properties of an iron. This fact is particularly important for the manufacture of chill rolls where a white zone of high hardness and a definite depth is required. Increasing the carbon content increases the hardness, but reduces the hardening depth. By removing the silicate slime, the carbon content, and consequently the hardness, can be increased without reducing the hardening depth.

In further experiments the effect of several factors upon the silicate-slime content, that is, the heredity in irons has been studied, the fineness of the graphite being taken as a criterion. An oxidising atmosphere (produced by passing air through the melt, or covering it with mill scale) does not increase the content of silicate slime, because the silicate thus formed is present in such a coarse state of division that it does not act as nuclei. Rise in temperature causes the silicate slime to separate from the iron bath. Diluting the iron by the addition of scrap increases the content of silicate slime, and consequently has a graphite-coarsening action in hypoeutectic irons with fine graphite. On the other hand, in irons with coarse hypereutectic graphite the scrap has a refining action by facilitating the solution of the graphite. Further addition of silicon to silicon-bearing cast iron has no deleterious effect, because at the usual silicon contents the oxygen combined with iron and manganese is practically nil. With basic slags containing 45 to 55 per cent. of lime, a noticeable refining of the graphite could be obtained at 1,400 deg. C., and a reaction time of 10 min. In smelting experiments carried out with various ores and slags of varying composition, it was found that acid and highly basic slags give pig-irons with fine graphite.

* Archiv für das Eisenhüttenwesen, vol. 7 (1933-34), No. 10.

A New Method for Preparing Moulding Sands

Binders International Company, Limited, of 9, Albert Place, Bridge Street, Manchester, have been granted Patent No. 401,217, and the following information is disclosed thereon.

Heretofore moulding sands have had a proportion of coal dust (termed coal or mineral blacking) mixed therewith, the coal dust having a predetermined analysis as far as ash and volatile matter contents are concerned. The effect of the coal dust is thought to be to increase the permeability of the moulding sand and to create a reducing atmosphere in the mould during the pouring of the molten metal.

Old moulding sands are usually regenerated by the addition of new clayey moulding sand and by dry or wet mixing. Certain agglomerants or binders can be used in the regeneration of old moulding sands and a proportion of new moulding sand can be replaced by agglomerant or binder. With the latter method, it is noticed that the regenerated sands possess many of the properties of the mixtures containing the special silica sands before referred to, namely, increase of permeability, resistance to compression and erosion and reduced adhesion to the surface of the castings. For sands prepared for green moulding, it is found that less water is required for correct moulding, which is very advantageous.

The invention cited has for its object to provide an improved material for use in making moulding sands, which enables regenerated moulding sand to be prepared with a minimum addition of new moulding sand and allows of a reduction in the quantity of water added in the preparation of green moulding sand.

The invention comprises an additive composition for moulding sands, consisting of coal dust mixed with a combustible binder in powder form.

The invention further comprises an additive composition for moulding sands consisting of coal dust mixed with dried pulverised waste wood-pulp liquor.

An example of this improved product, which is prepared in a mill or mixing machine, is:—Coal dust, 75 parts by weight; powdered sulphite lye, 25 parts by weight.

Examples of other combustible binders which may be added to the coal dust in dry powder form are dextrine (coregum), farina and linseed.

The improved composition may be incorporated in old moulding sand with or without the addition of new moulding sand. About one-half of the improved product is required in comparison with ordinary coal dust as at present used.

A green moulding sand for castings of from 2 to 40 lbs. weight may be made in a foundry mixing machine by placing therein 100 parts of old moulding sand, either dry or moist, and 2 parts of our improved product. Moisture is added to the mixture to obtain the desired plasticity whilst mixing proceeds. The sand, when mixing is completed, is ready for use.

The product does not during the casting operation give off any appreciable quantity of gas which might cause blow-holes, punctures and surface defects. In addition, as it requires a minimum addition of water, there is a lower emission of vapour during casting, which lessens the liability of faulty castings being produced.

THE ORDER for the hull and engines of a 9,100-ton motor vessel placed by Messrs. B. J. Sutherland & Company, Limited, of Newcastle, with Messrs. William Doxford & Sons, Limited, Sunderland, will mean the reopening of the shipbuilders' Sunderland yard, which has been closed for three years. Work will now be found for 400 or 500 men.

Birmingham Branch-President

ENCOURAGING PROSPECTS FOR THE COMING YEAR

At the annual meeting of the Birmingham, Coventry and West Midlands Branch of the Institute of British Foundrymen, Mr. G. T. Lunt, of Wolverhampton (Bradley & Foster, Limited), was unanimously elected President for the ensuing year, and Mr. G. M. Callaghan (Birmingham) was elected Senior Vice-President. Mr. E. J. Lewis (retiring President), of West Bromwich, took the chair at the outset.

The Year's Work

MR. L. W. BOLTON, as hon. secretary, giving the annual report, stated that at the beginning of the year it was necessary to remove some names from the membership list owing to arrears of subscriptions, although this action was not taken in cases arising from difficult industrial conditions. Recently, on account of the brighter outlook in trade, a number of new members had been enrolled, so that the total membership showed practically no change. The figures were—105 members, 115 associate members, 16 associates and two subscribing firms. In all, 22 new members had been elected or transferred to the Branch during the year. Ten Branch meetings had been held during the session, one of which was a joint meeting with the Midland Metallurgical Societies, and took the form of an open discussion on "The Production of Sound Iron Castings." On the whole, good discussions were obtained on the Papers presented. These meetings had been held in the James Watt Memorial Institute, in what is one of the most modernly-equipped lecture rooms in the country. The reading room is open daily, and may be used by all members of the Branch. The annual dinner, held at Birmingham Imperial Hotel in January, was a very successful event, 142 members and ladies attending. Works visits were arranged to the Midland Electric Manufacturing Company, Limited, and the General Electric Company. Both were extremely popular; it had been necessary to arrange a second visit to each works. It was decided by the Institute during the year to award a new medal for meritorious services over a long period. Members would no doubt be pleased to learn that the first member to receive this award was Mr. Finch, now of Stroud. Mr. Finch was a member of the Birmingham Branch and the oldest member of the Institute, as well as its first secretary.

The Branch had been well represented on the Technical Committee of the Institute, as, apart from the two delegates to the Technical Council elected by the Branch, eight other members of the Branch had been co-opted on the various sub-committees. Mr. J. W. Gardom, the Convenor of the Technical Council and Technical Committee, was now a member of the Birmingham Branch, having transferred recently from the London Branch. Dealing with the Branch finances, Mr. Bolton mentioned that the subscriptions dropped by about eight guineas, but expenses were about £3 less than the previous year, otherwise the accounts were very similar. On the motion of MR. E. S. MORGAN, seconded by MR. LEWIS, the report and accounts were adopted.

The New Officers

MR. LEWIS congratulated Mr. Bolton on his report, and, after acknowledging his active assistance as Secretary, proceeded to say that Mr. Lunt had been most regular in attending the Council meetings since he took office two years ago, and he had much pleasure in proposing that he should now become President. This MR. G. W. BROWN seconded, saying that Mr. Lunt was intensely interested in the foundry business and would uphold the traditions of the chair. Acknowledging his election, MR. LUNT (who then took the chair) said he was deeply conscious of the honour, especially as he was not a practical foundryman. But he was keenly interested in the work of the Institute, and had one thing in common with the rest of them, because he gained his living out of the products of the foundry trade. It was a common bond, and whether they were suppliers, suppliers' manufacturers or merchants, each could do their bit to help the trade and the status of the foundry industry generally.

MR. F. J. COOK then moved a cordial vote of thanks to the retiring President, and in observing that he was a practical foundryman, said that as such he brought a mentality to bear on his work in the chair which was different from that of some who had preceded him; and it was all to the good that succeeding Presidents should bring a different light to bear on the problems of the industry. In Mr. Lewis they had a practical foundryman of the first order. MR. MORGAN seconded, and the vote was carried.

On the proposal of the PRESIDENT, seconded by MR. W. J. MOLINEUX, Mr. G. M. Callaghan was elected Senior Vice-President. Mr. G. W. Brown was elected Junior Vice-President.

MR. D. H. WOOD proposed the re-election of Mr. L. W. Bolton as Hon. Secretary and Treasurer, and said that first as Assistant Secretary and then as Secretary he had filled the office with credit and ability. MR. COOK seconded, remarking that while he was conscious that from the start the Branch had been served by very capable secretaries, Mr. Bolton had lived up to the best of them. The proposition was carried unanimously, and as Assistant Secretary MR. H. J. ROE proposed Mr. A. A. Timmins, who is associated with Mr. Bolton at the B.C.I.R.A.

Welcome to Mr. Gardom

Four elections for the Branch-Council were needed, two members (Mr. H. C. Heggie and Mr. E. M. Currie) having resigned and Mr. Brown becoming a member *ex officio*. A ballot was taken, and it was announced that Messrs. Roe, Gardom, Tipper and Johnston were elected.

Five members were required for election as delegates to the General Council. These were Mr. J. B. Johnson, Mr. W. J. Flavell, Mr. J. W. Gardom, Mr. G. M. Callaghan and Mr. H. J. Roe. MR. COOK mentioned that as Mr. Gardom was Convenor of the Technical Committee he ought to be an *ex officio* member of the General Council. It would be remiss on their part if they did not propose him, as there appeared to be a loophole in the rules. The PRESIDENT agreed, saying in electing Mr. Gardom they would be honouring the Branch. MR. LISTER seconded the nomination. Two delegates were required for the Technical Council. MR. ROE proposed the re-election of Mr. J. G. Pearce (Birmingham) and Mr. F. J. Hemming (Walsall), the PRESIDENT endorsing the latter's commendation that the Branch was well represented by those two highly-qualified gentlemen. The motion was carried unanimously.

Iron and Steel Import Duties

Extended for Further Indefinite Period

Under the Additional Import Duties (No. 18) Order, 1934, issued by the Treasury on the recommendation of the Import Duties Advisory Committee, the Customs duties on iron and steel, which under the Additional Import Duties (No. 8) Order, 1932, are due to expire on October 25, 1934, are made chargeable without any limit of period.

A White Paper (Cmd. 4589) containing the Treasury Order and the Committee's report is published by the Stationery Office.

The Stanton Iron Road in the New Mersey Tunnel

In our issue of April 19, we described the mechanised foundry at the Holwell Works of the Stanton Ironworks Company, Limited, which is being used for the manufacture of Stanton "Hard-Stud" cast-iron road sections. By far the most important contract yet carried out by this plant was for the supply of the 4,600 tons of cast-iron "Hard-Stud" road sections which have been laid in the new Mersey Tunnel. It is in the belief that a description of this roadway will prove of interest to readers of our previous article that we append the following details.

The Mersey Tunnel is now equipped with the largest cast-iron highway in existence. Some three miles in length, it has a total area of 46,000 sq. yds., and is built up of 384,000 full sections, each $1\frac{7}{8}$ in. deep and covering an area of 1 sq. ft., 29,000 studded half-sections and 26,000 plain half-sections. These cast-iron sections were laid on a foundation of reinforced concrete, over which had been squeegeed a film of hot bituminous grout, known as "Stanphalt." As no fire was permitted within the tunnel, this material was heated outside to slightly over the required temperature of 420 deg. Fah., the complete boiler being then conveyed to the point at which laying was taking place.

The main roadway is 36 ft. wide, and is divided into four traffic lanes by lines consisting of amber-coloured rubber blocks alternating with the cast-iron sections. Each traffic lane is 8 ft. 6 in. wide, the faster traffic being confined to the two inner lanes. At each end of the tunnel the road branches into two approaches; in each of these branches the road is 19 ft. wide and contains two traffic lanes divided by a central line.

In view of the key position which the tunnel will occupy amongst the Merseyside traffic routes, it is essential to avoid repair work. Although slightly more expensive than the ordinary type of road surface, which requires frequent renewal, the iron road is durable enough to withstand the most exacting conditions, and requires no attention once it has been laid. It is anticipated, therefore, that the maintenance economies effected by its adoption will more than justify the slight increase in initial expenditure.

Import Duties Applications

The Import Duties Advisory Committee give notice of the following applications:—

(1) For an increase in the import duty on (*a*) jack and mattress chain and other similar chain of iron or steel wire, whether plated, coated or galvanised or not; (*b*) articles of iron or steel manufactured wholly or mainly of wire, whether plated, coated or galvanised or not, other than cable, rope and chain, all kinds of nails, staples, tacks, etc., upholstery and mattress springs, wire netting, fencing and mesh.

(2) For the addition to the Free List of silicon and alloys or mixtures thereof containing not less than 95 per cent. of silicon.

(3) For the amendment, together with the extension of the period of operation, of the Import Duties (Drawback) (No. 10) Order, 1933, under Section 9 of the Finance Act, 1932, allowing drawback in respect of certain billets of steel used in the manufacture of hollow mining drill steel.

Any representations which interested parties may desire to make in regard to these applications should be addressed in writing to the Secretary, Import Duties Advisory Committee, Caxton House (West Block), Tothill Street, Westminster, S.W.1, not later than June 11.

The Committee announce that they have decided not to make any recommendations in respect of the applications previously advertised for the addition to the Free List of alloys or mixtures of calcium and silicon or of calcium, silicon and iron, containing not less than 20 per cent. of calcium and not less than 60 per cent. of silicon.

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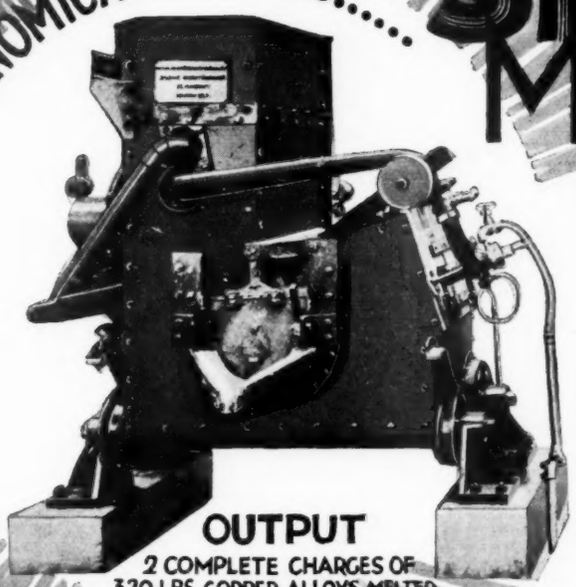

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This Week's News in Brief

Trade Talk

MR. YOSABURO ITO has been appointed manager of Mitsui & Company, Limited, Royal Mail House, 14-19, Leadenhall Street, E.C.3, in succession to Mr. Katsunosuke Shimada.

HERBERT MORRIS, LIMITED, Loughborough, have again received, for over the twentieth year in succession, the contract from the Admiralty for the supply of pulley blocks.

THE DIRECTORS, staff and workpeople of Messrs. F. Parramore & Sons (1924), Limited, Caledonian Foundry, Chapeltown, Sheffield, on Tuesday witnessed the ceremony of starting up the firm's newly-installed balanced-blast cupola.

AT THE FALKIRK DEAN OF GUILD COURT, last week, Messrs. R. & A. Main, Limited, Gothic Iron Works, Falkirk, craved warrant which was granted for the erection of an extension to their stores and warehouse accommodation, at an estimated cost of £1,100.

MESSRS. WILLIAM DENNY & BROS., LIMITED, Dumbarton, launched from their Leven shipyard the motor vessel "Lochnevis," which has been built to the order of Messrs. David MacBrayne, Limited, for the West Highland service. The propelling machinery is of the Diesel-electric type.

MESSRS. D. & W. HENDERSON & COMPANY, LIMITED, Partick, Glasgow, have received an order to build two steamers for Messrs. H. Hogarth & Company, Limited. The vessels will be of the shelter-deck type and have a gross tonnage of about 3,700 each of a special design, to be delivered early in 1935.

AT A MEETING of the Greenock Dean of Guild Court, plans were passed for an extension to the Watt Memorial School, Greenock, which stands on the site of James Watt's birthplace. The new building will be in harmony with the existing school and will accommodate technical classes at present housed elsewhere.

MESSRS. ATELIERS H. CUENOD, Geneva, who have been known for over 30 years as specialists in the Thury system of automatic regulators for generating plant and electric furnaces, and also as specialists in power-factor regulators, and the automatic regulation of steam, air and gas, have arranged for Messrs. Piggott Electrical Company, Limited, Salisbury Square House, E.C.4, to take over their selling agency in Great Britain.

AT THE LAST annual meeting of the British Cast Iron Research Association, the following new members were elected:—*Ordinary Members.*—Carmuirs Iron Company, Limited, Falkirk (representative, Mr. George C. Wilson); Willey & Company, Limited, Exeter (representative, Mr. E. R. H. Johnson). *Trade and User Member.*—Drysdale & Company, Glasgow (representative, Mr. J. Young). *Associate Members.*—Mr. James Bayley Butler, M.A., M.B., M.R.I.A., M.B.E., Dublin; and Mr. H. Taylor, B.Sc., Barrow-in-Furness.

A PARTY OF 60 members of the Yorkshire Junior Gas Association, on May 16, paid a visit of inspection to the works of the Staveley Coal & Iron Company, Limited, near Chesterfield, where they paid particular attention to the work and products of the sand-spun pipe plant, after which the company arranged a breaking test on a pipe, showing that sand-spun cast iron will bend rather than break. After luncheon the visitors inspected the company's by-product plant at Devonshire Works, and were shown a film of a series of pipe layings at Rotherham with the Staveley flexible joint.

UNUSUALLY LARGE CONSIGNMENTS of ore to Scottish ports in the early days of this month were followed by heavy arrivals last week; 17,000 tons arrived at Grangemouth, the greater part of this quantity going to the Carron Iron Company. This company, in common with all others producing pig-iron, is well employed. They are also busy with light castings, which is one of the busiest industries in the whole range of iron and steel activity in Scotland. All foundries in the Falkirk area are working full time, unemployment among moulders having been reduced to negligible proportions.

FOLLOWING UPON A DISPUTE which arose over the wage rate for a particular job, and which subsequently developed along more serious lines, 150 moulders in the employment of the Grangemouth Iron Company, Limited, Falkirk, have struck work. Originally, only half-a-dozen men were involved, the difference between them and their employers being one concerning the rate of remuneration to be paid for a particular class of pipe moulding. The men felt that the rate offered was unreasonable, and in this view they were supported by the Ironfounding Workers' Association. Negotiations with a view to arranging better terms were entered into, but without success, and in view of the absence of a prospect of agreement being reached, the six men involved were instructed to withdraw their labour. The manager of the foundry then proceeded to introduce non-union men, to which exception was taken by the moulders generally, and with the sanction of their union they promptly downed tools last Friday. At the moment there seems little prospect of an early settlement. The majority of the men on strike are members of the Ironfounding Workers' Association, and a few belong to the National Union of Foundry Workers. The same question regarding the pipe-moulding job has arisen at the Camelon Iron Company's foundry, and at the Burnbank Foundry Company, Limited, but in neither has any attempt to introduce non-union labour been made, and only about half-a-dozen men have been withdrawn and the other workers have continued as usual.

Alloys in the Foundry

(*Concluded from page* 331.)

It has been the author's endeavour to put forward a practical man's views of alloys in the iron foundry, and although theory and practice must go together to get the best results, he feels that the practical man sometimes is content to miss a splendid opportunity. A practical man with a technical knowledge has always the advantage over the purely scientific individual because, invariably, it is the practical man who must be consulted when some scientific idea is to be put to a practical test. Therefore the author strongly urges the practical man, especially with the facilities that exist to-day for learning, to acquire the technical side of his job and thereby fit himself for the highest position in the foundry, a position which he ought, by virtue of his practical experience, to hold, and if he does not, it is entirely his own fault.

Contracts Open

Dublin, May 30.—Iron and steel stores, for the Great Southern Railway Company. The Stores Superintendent, General Stores Department, G.S. Railways, Inchicore, Dublin.

Ecuador, June 6.—Structural iron and steel, for the Ministry of Public Works, Quito. The Department of Overseas Trade. (Reference G.Y. 13.760.)

Egypt, June 26.—Galvanised-iron pipes and metals, for the Egyptian Ministry of Public Works. The Department of Overseas Trade. (Reference G.Y. 13.796.)

Margate, May 28.—Weighbridge, capacity 20 tons, for the Town Council. Mr. P. T. Grove, town clerk, 40, Grosvenor Place, Margate.

Skegness, May 28.—Pumping machinery, for the Urban District Council. Mr. R. H. Jenkins, waterworks engineer and manager, Town Hall, Skegness. (Fee £2 2s., returnable.)

New Companies

Magnesium Castings & Products, Limited.—Capital £40,000. Subscriber: B. Griffin, 2, Bond Court, Walbrook, E.C.

Metal Securities, Limited, 75-79, Coleman Street, London, E.C.2.—Capital £1,250,000. Directors: O. Lyttelton, J. H. C. E. Howson and A. J. G. Murray-Graham.

Aulmalloy Company (Bristol), Limited.—Capital £1,000. Manufacturers of, and dealers in, goods in aluminium, alloys of aluminium, etc. Directors: F. M. Burris, 7-16, Redcliffe Street, Bristol; W. J. Edmonds and E. H. Burris.

Personal

MR. HAROLD E. COOKSON, managing director of C. Akrill & Company, Limited, has been elected President of the Staffordshire Iron and Steel Institute for the coming year. This will be Mr. Cookson's second year of office.

MR. SHEPPARD T. POWELL, consulting sanitary and chemical engineer, Baltimore, U.S.A., who will deliver the Ninth Edgar Marburg Lecture at the 1934 annual meeting of the American Society for Testing Materials, to be held in Atlantic City, N.J., June 25-29, has chosen as his subject "Water as an Engineering and Industrial Material." Mr. Powell, who is an outstanding authority on water and its problems, will review briefly the uses of water in engineering and industrial projects, stressing the variety of specifications required to meet the varying demands.

ON WEDNESDAY NIGHT a deputation from the employees of Stewarts and Lloyds, Limited, Sun Foundry, Coatbridge, waited upon Mr. Jefferson at his residence in Glenmavis. The company were entertained to tea by Mr. and Mrs. Jefferson. During the evening Mr. Ballantyne, in a short speech, spoke of Mr. Jefferson's loyalty to Stewarts and Lloyds, Limited, and his interest in the welfare of the workmen. He also added a word of appreciation from the staff and called upon Mr. Robertson to carry out the principal business of the visit. Mr. Robertson spoke of his long connection on the staff with Mr. Jefferson, and assured him that, when the word of his retirement as manager of Sun Foundry was heard, the employees were unanimous in wishing to give him something as a remembrance of his time spent at Sun Foundry. Mr. Robertson asked Mr. Jefferson to accept a camera and Mrs. Jefferson a handbag, as a token of their esteem. Mr. and Mrs. Jefferson suitably replied. Messrs. Stark, Hamilton and McLaren also spoke. Mr. Jefferson started work at Stewarts and Lloyds, Limited, Sun Foundry, in 1906, and superintended the laying-down of the foundations of the buildings and plant from the start, through the growth of the works until the end of 1933.

Will

CONNELL, WILLIAM CUTHBERT SMITH, shipbuilder, Glasgow £497,360

Obituary

THE DEATH OCCURRED very suddenly, at his residence in Greenock, of Mr. Louis Vaudalle Fulton, iron merchant and shipowner.

THE SUDDEN DEATH OF Mr. William Lawrie, a young Glasgow man, who was constructional expert in London for Messrs. Walter Macfarlane & Company, ironfounders, Possilpark, Glasgow, is deeply regretted in trade circles. Mr. Lawrie was only 32 years of age.

MR. G. E. RICHMOND SMITH, who died on Sunday, May 13, at the age of 68, had been connected with Messrs. Gjers, Mills & Company, Limited, Middlesbrough, for 55 years. He joined the staff as a boy of 14 and rose to become commercial manager and a director of the firm.

MR. ARCHIBALD STEWART, an assistant secretary of Messrs. Stewarts and Lloyds, Limited, died at Oakham Hospital, Rutland, on Tuesday, following a motoring accident. Mr. Stewart, whose firm is engaged on the erection of new Bessemer steelworks at Corby, Northamptonshire, had been temporarily residing at Oakham, while fulfilling the duties of office manager at the Corby works.

THE DEATH OCCURRED, at his home in Uddingston, of Mr. Gavin Allan Shanks, J.P., who was associated for many years with the late Sir Archibald McInnes Shaw in the firm of Shaw & McInnes, Limited, Firhill Iron Works, Glasgow. Mr. Shanks retired from the firm in 1932, and at the time of his death was in the 70th year of his age. He had been a Justice of the Peace for over 30 years, and for 23 years one of the most active workers in the Lanark County Council.

Forthcoming Event

JUNE 5-8.

Institute of British Foundrymen.—Annual Conference in Manchester.

FOUNDRY BOXES

...that speed up production for the Modern Foundry—

One of the greatest improvements you can introduce into your foundry is the STERLING ROLLED STEEL MOULDING BOX . . . . the result is speed and economy all round. Your moulders will put down more moulds per day because of the light and easy handling properties of these boxes.

You will be sure of producing accurate castings because STERLING BOXES maintain their accuracy permanently. Also your moulding costs will be halved—STERLING BOXES stand up to heavy service, anywhere.

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MOULDING BOX EQUIPMENT

Save their cost in a few months, and are obviously a sound investment for any foundry.

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LONDON OFFICE:— 13, VICTORIA STREET, S.W.1.

Agents at GLASGOW and MANCHESTER

Raw Material Markets

A greater feeling of confidence has been noticeable in the iron and steel trade following on the Government announcement that the iron and steel import duties are to be continued indefinitely. The industry is now free to launch out on schemes of general and individual reorganisation. Trading has been on the quiet side during the past week, owing to holiday influences.

Pig-Iron

MIDDLESBROUGH.—The holiday slackening-off in consumption caused little anxiety to the manufacturers of Cleveland iron, who are able to dispose of their entire current output, and have sufficient work on hand to last them for several months. Local consumption of pig-iron in the steelworks remains heavy, and there has been little or no falling-off in shipments to Scotland. Stocks of iron are at a low level, and are still having to be drawn upon at times to meet current commitments. Prices remain unchanged, at the fixed minimum levels.

East Coast hematite, which continues to meet with heavy local consumption, is also in strong demand from Sheffield and the Midlands, whilst deliveries have now been resumed to South Wales. There is still a strong inquiry, and consumers do not hesitate to pay the fixed prices, which for No. 1 hematite are 68s. per ton delivered Middlesbrough, 70s. delivered Durham and Northumberland, 74s. to 77s. delivered Yorkshire, 75s. delivered Scotland, 76s. delivered Lancashire, and 79s. delivered Birmingham.

LANCASHIRE.—Most of the pig-iron consuming establishments in this area were closed for the greater part of this week, and this has naturally affected trading. A noticeable feature of the market lately has been the disinclination of consumers to enter into long-term contracts, as it is felt that any early upward movement in prices is extremely unlikely. Prices are steady all round, with current offers of Derbyshire, Staffordshire and North-East Coast brands of No. 3 foundry iron for delivery to users in the Manchester zone on the basis of 74s. per ton. Northamptonshire at 72s. 6d., Derbyshire forge at 69s., Scottish foundry at about 83s., East Coast hematite at 76s. for No. 1 grade and 75s. for No. 3, and West Coast hematite at 80s. 6d. per ton.

MIDLANDS.—There continues to be a good demand for Midland iron against contract, but the volume of new bookings has been limited. Activity in this direction should expand shortly, as there will be a number of contracts expiring within a month or so. No change in prices has been occasioned. The minimum Association levels applying to Birmingham and Black Country stations are 67s. 6d. for No. 3 Northants and 71s. for Derbyshire, Staffordshire and Lincolnshire No. 3. These prices are subject to a sliding scale of rebates to large consumers. Scottish No. 3 and other low-phosphorus iron is in fair demand by the engineering trade. Scottish iron ranges from 85s. to 87s. 6d. and other irons from 81s. to 85s., with medium-phosphorus pig between 70s. and 80s. per ton. There is also a limited demand for refined pig-irons, which are quoted between £5 15s. and £6 15s. per ton, according to analysis.

SCOTLAND.—Little new business has been transacted in Scottish foundry iron. Prices are unchanged. The light-castings trade remains active, and good deliveries are being taken of Cleveland, which is quoted at 67s. 3d. per ton at Falkirk and 70s. 3d. at Glasgow. Contracts have been entered into by the foundries for several months ahead.

Coke

The foundry coke market maintains its firm tone, and there is talk of increased prices in the near future. Current quotations, for delivery in the South Staffordshire area, are as follow:—Best Durham coke, 36s. 6d. to 40s.; Welsh coke, 37s. 6d. to 45s.; Scottish coke, 41s. to 42s. per ton.

Steel

While new business has necessarily been limited during the past week by holiday influences, the steel market nevertheless maintains a firm tone. Conditions are somewhat irregular in the semi-finished steel trade, keen Continental competition being experienced, but most of the producers have a good amount of work on hand. Trade in heavy finished products is gradually improving. There is still a good demand for small bars and strip, in spite of competitive quotations from overseas producers.

Scrap

A firmer tone is apparent in the Cleveland scrap-iron market, but so far there has been no alteration in quotations. Steady conditions prevail in the Midlands, where heavy machinery is quoted at 55s., good heavy metal at 50s., and clean light scrap at 47s. 6d., all delivered works. In South Wales, cast-iron machinery scrap for foundry purposes is still rather a dull trade, but there has recently been more activity in light metal, and contracts have been arranged at 42s. per ton. Trade has been on the limited side in Scotland, where machinery scrap is quoted at 56s. 3d., and ordinary cast-iron scrap, suitable for foundries and in pieces not exceeding 1 cwt., at 52s. 6d. to 53s. 6d.

Metals

Copper.—Quotations in the standard copper market have again shown an easier tendency during the past week, following upon uncertainty as to the American situation. It is held that any beneficial effects of the copper code will not be felt by the market for some time yet, especially in view of the large stocks of metal that are still in existence, although it is true that the latter have lately shown a declining tendency. The industrial demand for copper in this country remains fairly good.

The German ban on purchases from abroad of refined and electro copper has been further prolonged until the end of the current month.

Daily quotations :—

Cash.—Thursday, £32 16s. 3d. to £32 18s. 9d.; Friday, £32 16s. 3d. to £32 18s. 9d.; Tuesday, £32 10s. to £32 11s. 3d.; Wednesday, £32 5s. to £32 6s. 3d.

Three Months.—Thursday, £33 2s. 6d. to £33 3s. 9d.; Friday, £33 2s. 6d. to £33 3s. 9d.; Tuesday, £32 13s. 9d. to £32 15s.; Wednesday, £32 10s. to £32 12s. 6d.

Tin.—At the meeting of the International Tin Committee, held on the 16th inst., it was decided to proceed with the formation of a buffer pool, the function of which will be to restrain excessive fluctuations in market quotations. Considerable criticism has been directed at the scheme, as it is felt that the market is likely to derive more harm than good from an excess of artificial control.

Business with consumers has been quiet in this country and on the Continent, and only moderate inquiry is reported in America. Consumption, nevertheless, is fairly well maintained, and favourable statistics are again expected at the end of the month. In view of the uncertainties which still surround the situation both as regards the general position in the United States of America and in the matter of production, it is difficult to express an opinion as to the future course of prices. Prospects for the maintenance of consumption seem reasonably good, and therefore a moderate recovery might be anticipated, state Messrs. Rudolf Wolff in their weekly report.

Market prices :—

Cash.—Thursday, £234 15s. to £235; Friday, £232 10s. to £233; Tuesday, £233 to £233 10s.; Wednesday, £232 12s. 6d. to £232 17s. 6d.

Three Months.—Thursday, £231 5s. to £231 10s.; Friday, £229 5s. to £229 10s.; Tuesday, £229 15s. to £230; Wednesday, £229 to £229 5s.

Spelter.—The demand for zinc in this country has been spasmodic, but quite satisfactory, when the depressed state of the galvanising industry is taken into consideration. Lack of demand from the Continent, however, combined with plentiful supplies of metal, has tended to keep down prices.

Day-by-day prices :—

Ordinary.—Thursday, £14 13s. 9d.; Friday, £14 12s. 6d.; Tuesday, £14 12s. 6d.; Wednesday, £14 10s.

Lead.—In spite of the improvement in consumption of this metal, the market is still depressed. The 10 per cent. tariff on imports into this country has failed to bring the Empire producers a better price for their lead, owing to the prejudicial effect on the market of large unsold stocks of foreign metal.

Market fluctuations :—

Soft Foreign (Prompt).—Thursday, £10 18s. 9d.; Friday, £10 17s. 6d.; Tuesday, £10 17s. 6d.; Wednesday, £10 15s.

Annual Conference in Manchester, 1934

FOURTH LIST OF SUBSCRIPTIONS TO CONFERENCE FUND

	£	s.	d.
Previously acknowledged	157	14	0
Messrs. David Bridge & Company, Limited, Castleton	5	0	0
Messrs. Tweedales & Smalley (1920), Limited, Castleton	5	0	0
W. H. Sherburn, Warrington ...	2	2	0
J. Hogg, Burnley	1	1	0
W. Holland, Manchester	1	1	0
Messrs. W. Woodcock, Sons & Company, Limited, St. Helens	1	1	0
B. Brownsmith, Preston	1	0	0
A. E. Wilson, Rochdale	1	0	0
E. S. Lord, Rochdale	0	10	6
J. Stanworth, Burnley	0	10	6
C. D. Cooper, Manchester	0	10	0
A. Sutcliffe, Bolton	0	10	0
H. Foster, Ormskirk	0	2	6
Total	£177	2	6

We are requested to state that the address of Quest Products, Limited, is Wharton Lodge Works, Winsford, Cheshire, not Birmingham, as shown in the third list of subscriptions.

Patent Specifications Accepted

The following list of Patent Specifications accepted has been taken from the "Illustrated Official Journal (Patents)." Printed copies of the full Specifications are obtainable from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. each. The last numbers given are those under which the Specifications will be printed and abridged, and all subsequent proceedings will be taken.

11,076. FOLLIET, A., and SAINDERICHIN, N. Treatment of iron castings to improve their physical characteristics. 404,180.

18,740. MORRIS, LIMITED, H., and HICKLING, H. R. Elevator systems, conveyor systems, or the like. 404,275.

3,627. HOESCH-KOLN NEUESSEN AKT.-GES. FÜR BERGBAU UND HUTTENBETRIEB. Production of corrosion-resistant iron alloys. 404,471.

21,276. KRUPP AKT.-GES., F. Manufacture of articles from steel alloys. 404,565.

15,128. LYSAGHT, LIMITED, J., and PLUMLEY, E. W. Conveying devices. 403,976.

18,061. MAUCLET, J. Production of iron or/and steel. 403,978.

31,974. QUASI-ARC COMPANY, LIMITED, and STROHMENGER, A. P. Electrodes or welding rods for use in electric-arc welding. 404,122.

31,263. SIEMENS & HALSKE AKT.-GES. Method of producing firmly adherent galvanic deposits on aluminium and its alloys. 404,251.

25,535. B.S.A. TOOLS, LIMITED, and OGILVIE, W. Machines for grinding cylindrical bodies. 404,403.

3,471. ROTHWELL, N., and SMITH, J. W. Chair supports for railway rails. 404,720.

20,434. TELEGRAPH CONSTRUCTION & MAINTENANCE COMPANY, LIMITED, WILD-BARFIELD ELECTRIC FURNACES, LIMITED, and COLEMAN, J. P. D. Pyrometer and like tubes for protection against furnaces gases. 404,670.

21,526. STOBIE, V. Crucible metal-melting furnaces. 404,741.

Scottish Branch Annual General Meeting

(*Concluded from page* 334.)

MR. J. CURRIE said that he was sure they would wish him to express to Sir Arthur Huddleston their heartiest thanks for having come to their meeting and distributed the awards, and to express the earnest hope that the pleasant relations between the Institute and the College would long continue.

A Paper on "Coke Research" was then read by MR. WILLIAM DAVIDSON.

COLD BLAST PIG IRON

for **CHILLED ROLLS,** CYLINDERS, CYLINDER LINERS, COG WHEELS FOR ROLLING MILLS, MORTAR MILL BOTTOM PLATES, STONE CRUSHER JAWS, PLOUGH-SHARES, ANVILS, AND ALL HIGH GRADE CASTINGS REQUIRING UNIFORMITY, DURABILITY, STRENGTH OR TOUGHNESS AND RESISTANCE TO GROWTH UNDER HEAT.

COLD BLAST PIG IRON IS THE BEST BASIS FOR ALLOY CAST IRON.

THE EARL OF DUDLEY'S ROUND OAK WORKS, LTD.,
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NEW WORKS, LOW MOOR,
BRADFORD - YORKSHIRE.
Brand : "LOWMOOR C.B."

MAKERS OF GENUINE COLD BLAST PIG IRON

RAW MATERIALS—PRICE LIST

(Wednesday, May 23, 1934)

COPPER

	£	s.	d.
Standard cash	32	5	0
Three months	32	10	0
Electrolytic	35	5	0
Tough	34	5	0
Best selected	34	15	0
Sheets	62	0	0
India	44	0	0
Wire bars	35	15	0
Ingot bars	35	15	0
H.C. wire rods	38	5	0
Off. av. cash, April	33	10	10½
Do., 3 mths., April	33	5	8¼
Do., Sttlmnt., April	33	0	10½
Do., Electro, April	36	5	9
Do., B.S., April	36	3	1½
Do., wire bars, April	36	10	9
Solid drawn tubes			10d.
Brazed tubes			10d.
Wire			6½d.

BRASS

Solid drawn tubes	9d.
Brazed tubes	11d.
Rods, drawn	8¾d.
Rods, extd. or rlld.	4½d.
Sheets to 10 w.g.	7½d.
Wire	7¾d.
Rolled metal	7d.
Yellow metal rods	4½d.
Do. 4 × 4 Squares	5¾d.
Do. 4 × 3 Sheets	5¾d.

TIN

	£	s.	d.
Standard cash	232	12	6
Three months	229	0	0
English	233	5	0
Bars	234	5	0
Straits (nom.)	233	5	0
Australian (nom.)			—
Eastern	231	15	0
Banca (nom.)			—
Off. av. cash, April	239	6	0
Do., 3 mths., April	237	13	8½
Do., Sttlmt., April	239	6	3

SPELTER

	£	s.	d.
Ordinary	14	10	0
Remelted	14	15	0
Hard	12	0	0
Electro 99.9	17	5	0
English	15	5	0
India	14	0	0
Zinc dust	17	0	0
Zinc ashes	3	5	0
Off. aver., April	15	1	1⅞
Aver. spot, April	14	18	3¾

LEAD

	£	s.	d.
Soft foreign ppt.	10	15	0
Empire	11	7	6
English	12	5	0
Off. average, April	11	12	11¼
Average spot, April	11	10	0

ALUMINIUM

Ingots	£100 to £105
Wire	1/1 to 1/9 lb.
Sheet and foil	1/2 to 2/9 lb.

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	23	10	0
Do., V.M. ex whse.	23	0	0
Rods	29	0	0

ANTIMONY

	£	s.	d.	£	s.	d.
English	42	0	0 to	43	0	0
Chinese, ex-whse.				35	0	0
Crude				25	0	0

QUICKSILVER

	£	s.	d.	£	s.	d.
Quicksilver	10	12	6 to	10	17	6

FERRO-ALLOYS AND STEEL-MAKING METALS

Ferro-silicon—	
25%	8 17 6
45/50%	13 0 0
75%	18 2 6
Ferro-vanadium—	
35/50%	12/8 lb. Va.
Ferro-molybdenum—	
70/75% carbon-free of Mo.	5/6 per lb.
Ferro-titanium—	
23/25% carbon-free	9d. lb.
Ferro-phosphorus, 20/25%	£14 10 0
Ferro-tungsten—	
80/85%	3/- lb.
Tungsten metal powder—	
98/99%	3/3 lb.
Ferro-chrome—	
2/4% car.	32 0 0
4/6% car.	23 0 0
6/8% car.	21 12 6
8/10% car.	21 12 6
Ferro-chrome—	
Max. 2% car.	37 10 0
Max. 1% car.	38 15 0
Max. 0.70% car.	42 0 0
70% carbon-free	10½d. lb.
Nickel—99.5/100%	£200 to £205
"F" nickel shot	£180 0 0
Ferro-cobalt, 98/99%	5/3 lb.
Metallic chromium—	
96/98%	2/5 lb.
Ferro-manganese (net)—	
76/80% loose	£10 15 0 to £11 5 0
76/80% packed	£11 15 0 to £12 5 0
76/80% export	(nom.) £9 15 0
Metallic manganese—	
94/96% carbon-free	1/2 lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL

Finished bars, 14% tungsten	2s. 0d.
Finished bars, 18% tungsten	2s. 9d.

Per lb. net, d/d buyers' works.

Extras—	
Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ⅛ in. to ¼ in.	3d. lb.
Do., under ¼ in. to ⅛ in.	1/- lb.
Flats, ⅛ in. × ¼ in. to under 1 in. × ⅛ in.	3d. lb.
Do., under ¼ in. × ¼ in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP

	£	s.	d.	£	s.	d.
South Wales—						
Heavy steel	2	12	6 to	2	15	0
Bundled steel and shrngs.	2	2	6 to	2	7	6
Mixed iron and steel	2	18	6 to	2	19	6
Heavy cast iron	2	7	0 to	2	8	0
Good machinery	2	10	0 to	2	12	6
Cleveland—						
Heavy steel				2	10	0
Steel turnings				1	17	6
Cast-iron borings				1	7	6
Heavy forge				2	10	0
W.I. piling scrap				2	5	0
Cast-iron scrap	2	10	0 to	2	13	0
Midlands—						
Light cast-iron scrap				2	7	6
Heavy wrought iron				3	0	0
Steel turnings, f.o.r.				1	12	6
Scotland—						
Heavy steel	2	10	0 to	2	11	3
Ordinary cast iron	2	12	6 to	2	13	6
Engineers' turnings				2	0	0
Cast-iron borings	2	0	0 to	2	1	6
Wrought-iron piling				2	11	3
Heavy machinery	2	16	0 to	2	16	6

London—Merchants' buying prices, delivered yard.

	£	s.	d.
Copper (clean)	27	0	0
Brass	19	10	0
Lead (less usual draft)	10	0	0
Tea lead	7	10	0
Zinc	9	10	0
New aluminium cuttings	70	0	0
Braziery copper	24	0	0
Gunmetal	25	0	0
Hollow pewter	155	0	0
Shaped black pewter	110	0	0

PIG-IRON

N.E. Coast (d/d Tees-side area)—	
Foundry No. 1	70/-
Foundry No. 3	57/6
,, at Falkirk	67/3
,, at Glasgow	70/3
Foundry No. 4	66/6
Forge No. 4	66/6
Hematite No. 1	68/-
Hematite M/Nos.	67/6
N.W. Coast—	
Hem. M/Nos. d/d Glas.	72/6
,, d/d Birm.	84/6
Malleable iron d/d Birm.	115/-
Midlands (d/d Birmingham dist.)—	
Staffs No. 4 forge	67/-
,, No. 3 fdry.	71/-
Northants forge	63/6
,, fdry. No. 3	67/6
,, fdry. No. 1	70/6
Derbyshire forge	67/-
,, fdry. No. 3	71/-
,, fdry. No. 1	74/-
Scotland—	
Foundry No. 1, f.o.t.	72/6
,, No. 3, f.o.t.	70/-
Hem. M/Nos. d/d	71/-
Sheffield (d/d district)—	
Derby forge	64/6
,, fdry. No. 3	68/6
Lincs forge	64/6
,, fdry. No. 3	68/6
E.C. hematite	80/6
W.C. hematite	83/6
Lancashire (d/d eq. Man.)—	
Derby fdry. No. 3	74/-
Staffs fdry. No. 3	74/-
Northants fdry. No. 3	72/6
Cleveland fdry. No. 3	74/-
Dalzell, No. 3 (special)	102/6 to 105/-
Glengarnock, No. 3	83/-
Clyde, No. 3	83/-
Monkland, No. 3	83/-
Summerlee, No. 3	83/-
Eglinton, No. 3	83/-
Gartsherrie, No. 3	83/-
Shotts, No. 3	83/-

FINISHED IRON AND STEEL

Usual district deliveries for iron; delivered consumer's station for steel.

	£	s.	d.	£	s.	d.
Iron—						
Bars (cr.)	9	12	6 to	9	15	0
Nut and bolt iron	7	5	0 to	8	0	0
Hoops	10	10	0 to	12	0	0
Marked bars (Staffs) f.o.t.				12	0	0
Gas strip	10	10	0 to	12	0	0
Bolts and nuts, ¾ in. × 4 in.	13	15	0			
Steel—						
Plates, ship, etc.	8	15	0 to	8	17	6
Boiler plts.	8	2	6 to	8	10	0
Chequer plts.				10	7	6
Angles				8	7	6
Tees				9	7	6
Joists				8	15	0
Rounds and squares, 3 in. to 5½ in.				9	7	6
Rounds under 3 in. to ⅜ in. (Untested)				8	12	0
Flats—8 in. wide and over				8	12	6
,, under 8 in. and over 5 in.				8	17	6
Rails, heavy	8	5	0 to	8	10	0
Fishplates	12	5	0 to	12	10	0
Hoops (Staffs)				—		
Black sheets, 24g. (4-t. lots)				10	10	0
Galv. cor. shts. (,,)				13	0	0
Galv. flat shts. (,,)				13	10	0
Galv. fencing wire, 8g. plain				14	10	0
Billets, soft				5	10	0
Billets, hard	6	17	6 to	7	2	6
Sheet bars	5	0	0 to	5	7	6
Tin bars				5	0	0

PHOSPHOR BRONZE

	Per lb. basis.
Strip	11d.
Sheet to 10 w.g.	12d.
Wire	12d.
Rods	11d.
Tubes	15d.
Castings	13d.

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	7d. to 1/1
Rolled—	
To 9 in. wide	1/1 to 1/7
To 12 in. wide	1/1½ to 1/7½
To 15 in. wide	1/1½ to 1/7½
To 18 in. wide	1/2 to 1/8
To 21 in. wide	1/2½ to 1/8½
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to 1/3½
Ingots rolled to spoon size	10d. to 1/6½
Wire round—	
to 10g.	1/4½ to 1/11½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3½ upwards.

AMERICAN IRON AND STEEL

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	20.26
No. 2 foundry, Valley	18.50
No. 2 foundry, Birm.	14.50
Basic, Valley	18.00
Bessemer	20.76
Malleable, Valley	18.50
Grey forge, Valley	17.50
Ferro-mang. 80%, seaboard	85.00
O.-h. rails, h'y, at mill	36.37½
Billets	29.00
Sheet bars	30.00
Wire rods	38.00
	Cents.
Iron bars, Phila.	1.94
Steel bars	1.90
Tank plates	1.85
Beams, etc.	1.85
Skelp, grooved steel	1.70
Steel hoops	2.10
Sheets, black, No. 24	2.65
Sheets, galv., No. 24	3.25
Wire nails	2.60
Plain wire	2.30
Barbed wire, galv.	3.00
Tinplates, 100-lb. box	$5.25

COKE (at ovens)

Welsh foundry	25/- to 27/6
,, furnace	20/-
Durham foundry	21/- to 25/-
,, furnace	17/6
Midlands, foundry	—
,, furnace	—

TINPLATES

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 per box		17/3 to 17/6
,,	28×20	,,	34/6 to 35/-
,,	20×10	,,	24/9 to 25/-
,,	18⅞×14	,,	18/- to 18/3
C.W.	20×14	,,	15/3 to 15/6
,,	28×20	,,	32/- to 32/6
,,	20×10	,,	22/- to 22/3
,,	18⅞×14	,,	15/6 to 15/9

SWEDISH CHARCOAL IRON & STEEL

	£	s.	d.	£	s.	d.
Pig-iron	£6	0	0 to	£7	0	0
Bars-hammered, basis	£16	0	0 to	£16	10	0
Bars and nail-rods, rolled, basis	£15	15	0 to	£16	0	0
Blooms	£10	0	0 to	£12	0	0
Keg steel	£30	0	0 to	£31	0	0
Faggot steel	£18	0	0 to	£23	0	0
Bars and rods dead soft, st'l	£10	0	0 to	£12	0	0

All per English ton, f.o.b. Gothenburg.
[Subject to an exchange basis of Kr. 18.16 to £1.]

DAILY FLUCTUATIONS

Standard Copper (cash)

		£	s.	d.	
May	17 ..	32	16	3	inc. 3/9
,,	18 ..	32	16	3	No change
,,	22 ..	32	10	0	dec. 6/3
,,	23 ..	32	5	0	,, 5/-

Electrolytic Copper

		£	s.	d.	
May	17 ..	36	0	0	No change
,,	18 ..	36	0	0	,, ,,
,,	22 ..	35	10	0	dec. 10/-
,,	23 ..	35	5	0	,, 5/-

Standard Tin (cash)

		£	s.	d.	
May	17 ..	234	15	0	inc. 50/-
,,	18 ..	232	10	0	dec. 45/-
,,	22 ..	233	0	0	inc. 10/-
,,	23 ..	232	12	6	dec. 7/6

Tin (English ingots)

		£	s.	d.	
May	17 ..	235	5	0	inc. 45/-
,,	18 ..	233	5	0	dec. 40/-
,,	22 ..	233	15	0	inc. 10/-
,,	23 ..	233	5	0	dec. 10/-

Spelter (ordinary)

		£	s.	d.	
May	17 ..	14	13	9	inc. 1/3
,,	18 ..	14	12	6	dec. 1/3
,,	22 ..	14	12	6	No change
,,	23 ..	14	10	0	dec. 2/6

Spelter (Electro, 99.9 per cent.)

		£	s.	d.	
May	17 ..	17	6	3	inc. 1/3
,,	18 ..	17	5	0	dec. 1/3
,,	22 ..	17	5	0	No change
,,	23 ..	17	5	0	,, ,,

Zinc Sheets (English)

		£	s.	d.	
May	17 ..	23	10	0	No change
,,	18 ..	23	10	0	,, ,,
,,	22 ..	23	10	0	,, ,,
,,	23 ..	23	10	0	,, ,,

Lead (English)

		£	s.	d.	
May	17 ..	12	5	0	No change
,,	18 ..	12	5	0	,, ,,
,,	22 ..	12	5	0	,, ,,
,,	23 ..	12	5	0	,, ,,

AVERAGE MONTHLY PRICES OF RUBIO ORE (MIDDLESBROUGH).

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1896	0 12 6	0 12 6	0 12 9	0 12 9	0 12 9	0 12 7	0 12 9	0 12 9	0 12 9	0 13 6	0 15 0	0 14 9	0 13 1
1897	0 15 3	0 15 6	0 15 3	0 15 0	0 14 0	0 14 3	0 14 3	0 14 0	0 14 0	0 15 0	0 14 3	0 15 3	0 14 6
1898	0 15 0	0 14 4	0 14 9	0 14 6	0 15 0	0 15 0	0 14 0	0 14 0	0 14 0	0 14 9	0 15 0	0 14 9	0 14 7
1899	0 15 0	0 15 3	0 15 6	0 15 6	0 15 9	0 16 0	0 17 6	0 18 0	0 17 9	0 18 0	0 19 0	1 0 0	0 16 11½
1900	1 1 0	1 0 6	1 1 0	1 0 9	1 1 0	1 1 0	1 1 3	1 1 6	1 1 3	1 1 3	1 0 0	0 18 0	1 0 8½
1901	0 17 6	0 16 0	0 15 0	0 14 6	0 15 6	0 15 9	0 14 9	0 15 3	0 15 9	0 15 9	0 15 9	0 15 9	0 15 7½
1902	0 15 6	0 15 0	0 16 0	0 16 0	0 15 6	0 15 3	0 15 6	0 16 0	0 16 0	0 16 0	0 15 9	0 15 6	0 15 8½
1903	0 15 6	0 16 0	0 16 6	0 16 3	0 16 3	0 16 10	0 15 9	0 15 6	0 14 9	0 14 9	0 15 1	0 15 3	0 15 8
1904	0 14 9	0 15 3	0 15 1	0 15 4	0 15 3	0 15 0	0 14 5	0 14 6	0 14 6	0 14 6	0 14 6	0 14 7	0 14 9½
1905	0 15 3	0 15 6	0 15 0	0 15 3	0 15 6	0 15 6	0 15 6	0 15 6	0 16 6	0 18 6	0 18 9	0 18 9	0 16 3½
1906	1 0 0	1 1 6	1 0 0	1 0 0	0 19 6	1 0 0	0 19 6	0 19 4	1 0 6	1 1 6	1 1 9	1 3 6	1 0 7
1907	1 3 6	1 2 6	1 2 6	1 2 0	1 1 6	1 2 3	1 2 3	1 2 0	1 1 0	0 19 0	0 18 9	0 17 6	1 1 2½
1908	0 16 6	0 15 0	0 15 6	0 15 6	0 15 3	0 15 0	0 15 0	0 14 9	0 15 0	0 16 0	0 16 0	0 16 0	0 15 5½
1909	0 15 9	0 16 3	0 16 0	0 16 0	0 16 3	0 16 6	0 16 0	0 16 0	0 17 0	0 17 0	0 17 6	0 17 6	0 16 6
1910	1 0 4	1 0 9	1 0 9	1 0 9	1 0 9	1 0 9	1 0 9	1 0 3	1 0 3	1 0 6½	1 1 3	1 1 5	1 0 9½
1911	1 2 2½	1 2 6	1 2 6	1 1 11½	1 0 11½	0 19 6	0 19 0	0 19 0	0 19 1½	0 19 6	1 0 0½	1 1 6½	1 0 7½
1912	1 2 3	1 2 6	1 2 6	1 1 6	1 1 6	1 1 6	1 1 6	1 2 3	1 2 6	1 3 0	1 3 0	1 2 11	1 2 2½
1913	1 2 9	1 2 2	1 1 7½	1 1 6	1 0 8½	1 0 0	1 0 0	1 0 0	0 19 10½	0 19 1½	0 19 0	0 19 0	1 0 5½
1914	0 18 7½	0 18 0	0 18 0	0 17 9	0 17 6	0 17 6	0 17 1½	0 19 7½	0 18 11½	0 17 10½	0 18 7½	1 1 0½	0 18 8½
1915	1 7 7½	1 8 6	1 9 3	1 10 2½	1 8 6	1 6 4	1 5 10½	1 6 0	1 6 10½	1 10 8½	1 13 0	1 17 10	1 9 1½
1916	1 18 6	2 0 1½	2 2 6½	2 0 6½	1 15 0	1 16 3	1 18 0	1 18 0	1 18 0	—	—	—	—
1917	} Price Fixed												
1918													
1919	—	—	—	—	2 5 7½	2 14 4½	2 16 4½	2 14 0	2 13 4½	2 13 0	2 12 7½	2 11 9	—
1920	2 17 0	3 7 9	2 15 6	3 6 7	3 0 0	2 15 0	2 14 0	2 9 9	2 7 6	2 11 0	2 12 3	2 10 0	2 15 0
1921	2 1 0	2 0 1½	1 18 3	1 17 6	1 17 6	1 17 6	1 17 6	1 5 0	1 8 9½	1 7 9	1 7 0	1 7 0	1 13 8½
1922	1 6 7½	1 5 10½	1 6 11	1 7 0	1 7 0	1 7 0	1 5 3	1 4 9½	1 4 2½	1 3 3½	1 2 6	1 2 3	1 5 2½
1923	1 2 9½	1 4 6½	1 5 2	1 4 8½	1 4 6	1 4 0	1 3 6	1 3 0	1 3 0	1 3 0	1 3 2½	1 4 9	1 3 10½
1924	1 4 2½	1 4 0	1 4 0	1 3 7½	1 3 8½	1 3 6	1 2 11	1 2 6	1 2 1½	1 1 7½	1 2 3	1 2 6	1 3 1
1925	1 2 6	1 2 1½	1 2 0	1 2 0	1 2 0	1 1 6	1 0 6	1 0 0	1 0 0	1 0 0	1 0 3	1 0 10½	1 1 1½
1926	1 1 1½	1 1 6	1 1 6	1 1 3½	1 1 3	1 1 5½	1 1 6	1 1 0	1 1 0	1 1 6	1 1 6	—	1 1 4½
1927	1 2 1½	1 2 3	1 2 1½	1 2 0	1 2 0	1 2 0	1 1 7½	1 1 0	1 1 0	1 1 0	1 1 0	1 1 0	1 1 7½
1928	1 1 0	1 1 1½	1 1 11	1 2 4½	1 2 6	1 2 6	1 2 6	1 2 6	1 2 6	1 2 6	1 2 6	1 2 6	1 2 2½
1929	1 2 6	1 2 6½	1 2 11½	1 3 0	1 3 0	1 3 2½	1 4 0	1 4 8½	1 4 7½	1 4 6	1 4 6	1 4 3	1 3 7½
1930	1 3 3½	1 2 6	1 1 9	1 1 6	1 0 10½	1 0 0	1 0 0	0 19 6	0 19 0	0 17 4½	0 16 4½	0 16 4½	0 19 10½
1931	0 16 1½	0 16 0	0 16 0	0 15 11½	0 15 4½	0 15 0½	0 14 10½	0 14 3½	0 14 6	0 16 8½	0 17 0½	0 16 6	0 15 9
1932	0 16 6	0 16 6	0 16 3	0 15 6	0 15 4½	0 15 0	0 14 11	0 14 8½	0 14 6	0 14 6	0 14 9	0 15 1	0 15 3½
1933	0 15 6	0 15 3	0 15 3	0 15 3	0 15 3	0 15 6	0 15 6	0 15 6	0 15 6	0 15 11½	0 16 6	0 16 6	0 15 7½
1934	0 16 6	0 17 6	0 16 9	0 16 6½	—	—	—	—	—	—	—	—	—

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TO Midland Founders.—Engineer-Salesman, well connected Midland engineering and allied trades, open to represent reputable firm of founders for sale of ferrous and non-ferrous castings. Commission basis.—Apply, Box 766, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

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Conducted by the Institute of British Foundrymen by courtesy of the proprietors of THE FOUNDRY TRADE JOURNAL.

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Any employer wishing to communicate with a candidate should write to the General Secretary, quoting identification number.

EXPERIENCED Foundry Foreman desires position. General engineering, jobbing, machine-moulding. Experienced in estimating, cupola practice, etc. (245)

YOUNG Foundry Foreman in charge of grey-iron, non-ferrous, malleable foundry, desires change. Willing to go abroad. (246)

PUBLICATION

RYLAND'S DIRECTORY of the Coal, Iron, Steel, Tinplate, Metal, Engineering, Hardware and Allied Trades. 1934 edition now ready. Price 42s. cloth bound, 52s. morocco. Order *YOUR* copy *NOW*.—INDUSTRIAL NEWSPAPERS, LIMITED, 49, Wellington Street, Strand, London, W.C.2.

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WANTED, several Britannia Jar-Ram MOULDING MACHINES; must be in good condition.—Box 760, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

30-TON CRANE WEIGHING MACHINE by Avery, Duckham's patent; in perfect adjustment. Price £42.

15-ton Denison Crane Weighing Machine; perfect adjustment. Price £28.

1-ton Denison Crane Weighing Machine; as new. Price £10.

Several smaller machines.

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ONE genuine Tabor Roll-over Shockless Jolt-ram MOULDING MACHINE to take 30-in. by 40-in. boxes; practically new; can be seen working. Price £120.

One Roll-over Shockless Tabor JOLTING MACHINE to take 60 in. x 48 in.; can be seen working. Price £160.

A. HAMMOND, 14, Australia Road, Slough.

MACHINERY—*Continued*

1-TON STOCK CONVERTER PLANT, oil-fired, complete with economiser, blower and all equipment; in first-class condition—ideal for small steel castings for the motor trade. Price £300.

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SAND-BLAST PLANTS AND AIR COMPRESSORS
(Tilghman's).
We have in stock :—
15 NEW SAND-BLAST PLANTS.
20 Re-conditioned Sand-blast Plants.
120 NEW AIR COMPRESSORS.
22 Re-conditioned Air Compressors.
All sizes—all pressures.
Sand-blasting and Metal-spraying for all Trades.

R. J. RICHARDSON & SONS, LIMITED, COMMERCIAL STREET, BIRMINGHAM, 1.

CRANE LADLES.
30-ton capacity Stevenson Crane Ladle.
20-ton capacity Stevenson Crane Ladle.
16-ton capacity Stevenson Crane Ladle.
15-ton capacity Stevenson Crane Ladle.
12-ton capacity Evans Crane Ladle.
10-ton capacity Evans Crane Ladle.
40 smaller Ladles in stock.
A. HAMMOND, 14, Australia Road, Slough.
'Phone 287 Slough.

SANDBLAST PLANTS

Room, Rotary Barrel and Cabinet Types complete; 12 in stock.

SAND PLANT

Sand Mills, 6-ft., 5-ft. and 4-ft. 6-in. dia. Pans.
Rotoil "Senior" Oil Core Sand Mixer.
Pneulec Sand Drying Plant, output 1 ton per hour.
Brearley Type Disintegrators.

MOULDING MACHINES

Hand and Pneumatic Types.
Also
Six Rowlands Double-ended Grinders for 24-in. dia. x 2-in. wheels.
Electrical and Belt-driven Blowers and Exhaust Fans, Ladles, etc., etc.

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All sizes for high and low pressures.

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Pneu. Sand MOULDING Machine, admit 16" x 16" x 6".
Motor-dr. Exhaust FANS, 14" (Sirocco), 12" sq. outlet.
100-h.p. MOTOR, 400/450 volts A.C. (E.E.C.), 720 r.p.m.
2 very good BABCOCK W.T. BOILERS, each 7,135 sq. ft. heating surface, 205 lbs. w.p., with superheaters, economisers, etc.
Write for "Albion" Catalogue.
'Grams: "Forward." 'Phone: 23001 (10 lines).
ALBION WORKS, SHEFFIELD

MISCELLANEOUS

FLUIDITY TESTS as described in THE FOUNDRY TRADE JOURNAL, February 1, 1934. Patterns of the above in aluminium can be supplied for 35s. per set. Post free. We can also supply Patterns for all branches of the engineering trade, in hard or soft woods. Send us your inquiries.—FURMSTON & LAWLOR, Patternmakers, Letchworth, Herts.

TIME RECORDERS (workpeople); guaranteed; must clear.—Box 734, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

MISCELLANEOUS—*Continued*

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12' × 9' Tilghman sandblast room, built of cast iron plates, complete with 400 cu. ft. Tilghman air compressor and all accessories **£290 Nett.**

T.B. 1 Tilghman sandblast barrel plant, complete. CHEAP.

T.B. 3 Tilghman sandblast barrel plant, double-jet, complete. CHEAP.

6' "Jackman" rotary sandblast table. CHEAP seen working.

SAND PLANT

Herbert "Whizzer" type disintegrator, No. 1 **£30**
Pneumatic riddle, by Macdonald **£8**
Large "Baillott" sand preparing plant CHEAP.

BUY FROM ME AND SAVE MONEY!

ALEX. HAMMOND, *Foundry Machinery Merchant,*
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PETER—WITH ONE EXCEPTION

With one exception Peter is an ordinary little fellow. Chubby, likeable, just five-and-a-half, full of life and fun and on occasions—be it admitted—of naughtiness.

Just now Peter's rather important, for this is his first term at school, and he's grappling with the intricacies of "A B C" and "Twice-Two": difficult subjects to all men of five-and-a-half, but even more difficult in Peter's case because—bad luck—he's totally blind. That's his One Exception.

Peter learns reading, writing, and 'rithmetic through the medium of "Braille"—dull stuff compared with the coloured picture books of most five-and-a-halfs. However, he's a stout lad is Peter, and he's making great progress.

Would you like to know more about him? How, in spite of his "One Exception," he is being educated and, when older, technically trained and usefully employed.

There is a long waiting list of "Peters" throughout the British Isles, for whom training and accommodation must be provided in the immediate future.

Will you help with a donation or annual subscription? Any sum, large or small, will be gratefully received.

Here's a suggestion. Your eyesight is worth 3d. a year to you. Send Peter and his handicapped pals 3d. for every year you've had it. Now, please, in case it slips your memory. Good idea?

The Chairman,
SCHOOL FOR THE BLIND
(Founded 1838),
SWISS COTTAGE, LONDON, N.W.3.